THE INSTITUTE OF PETROLEUM

REVIEW

December 1960

V. 14 #168

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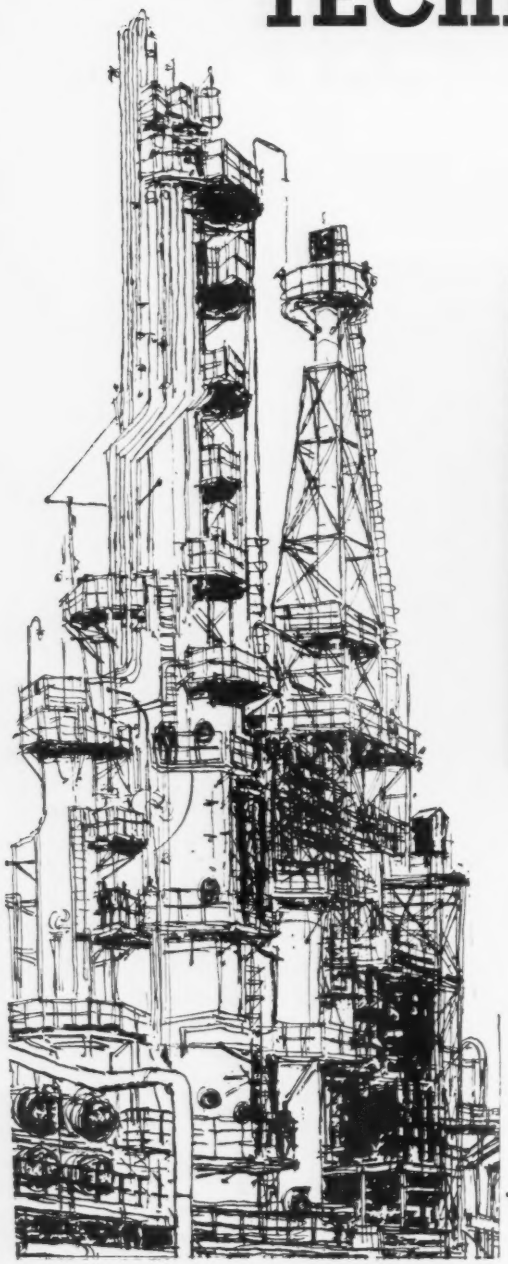

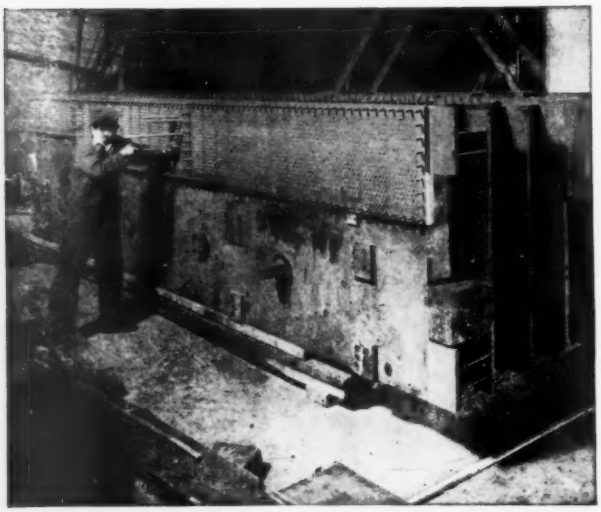

A 50,000 gal. day evaporator for a refinery under construction by Procon (Great Britain) for Anglo Ecuadorian Oilfields, Ltd., being tubed with SERCKALBRA.
(Photograph by courtesy of Richardson, Westgarth and Co., Ltd.)

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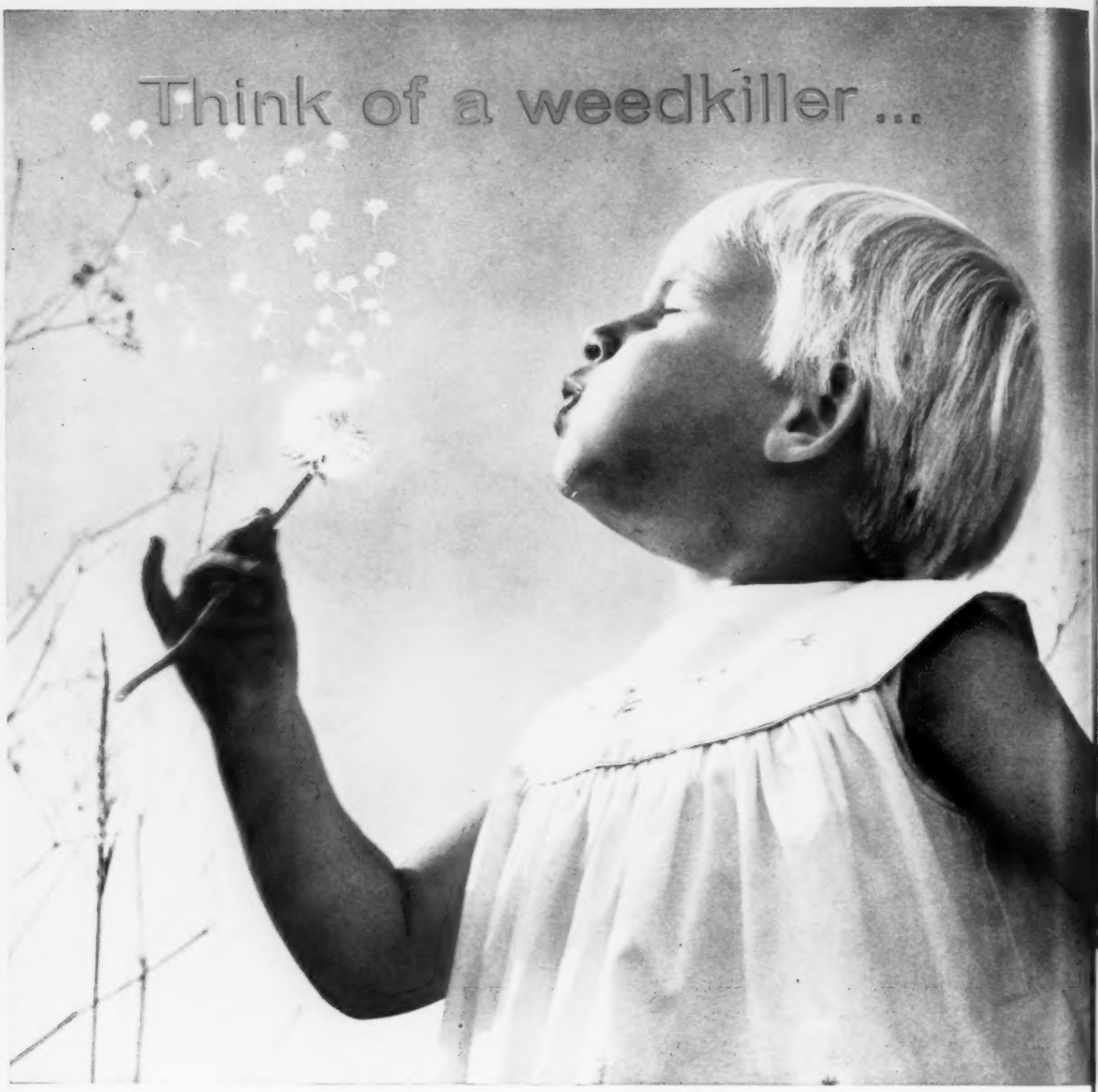

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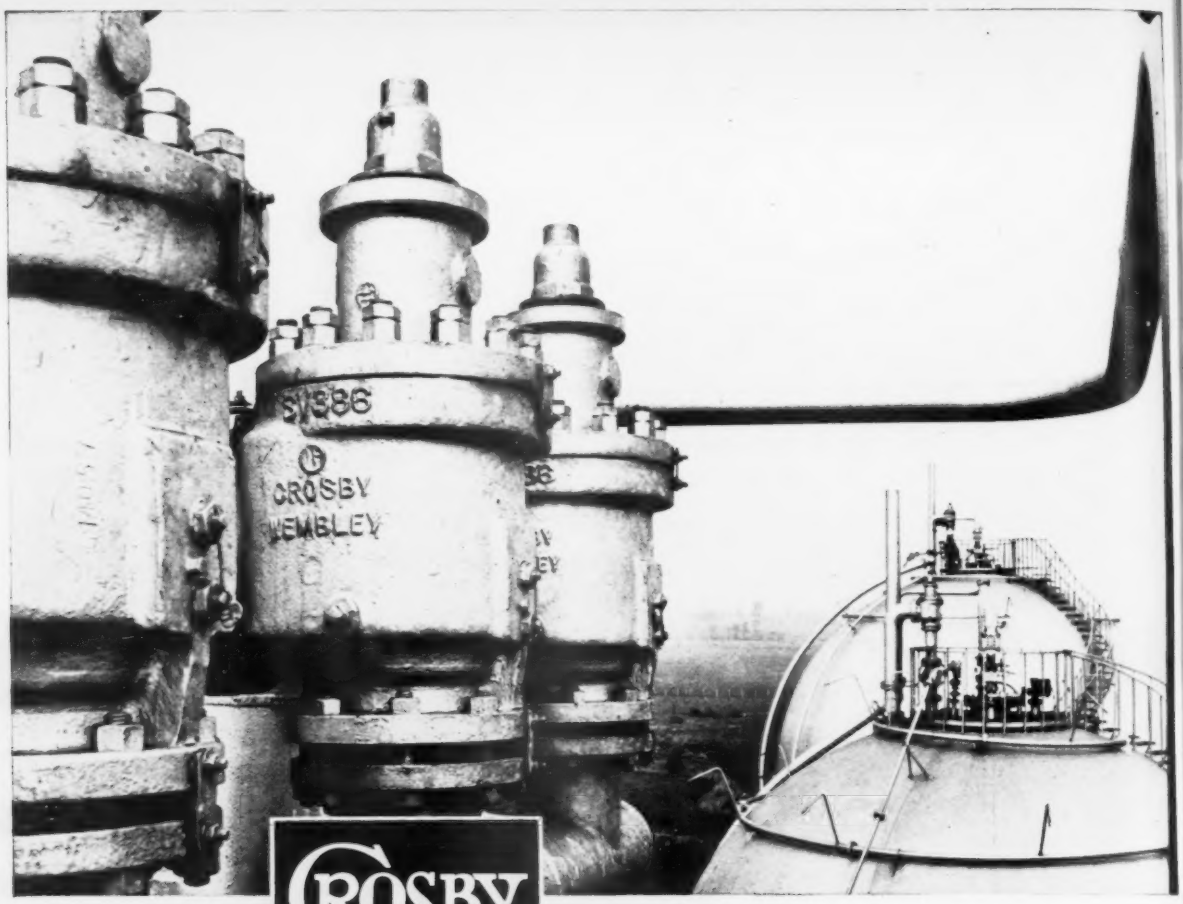

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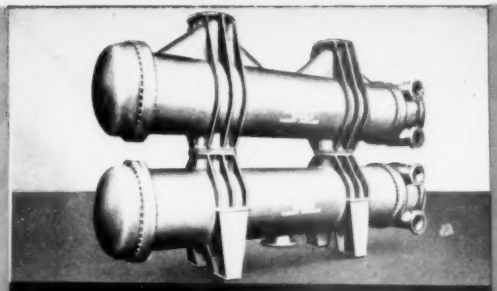

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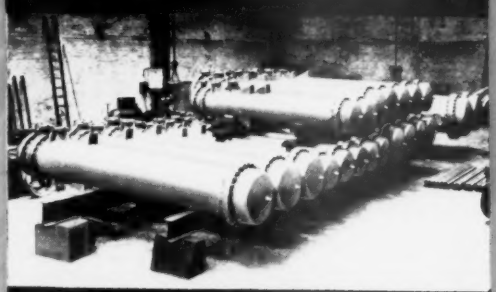

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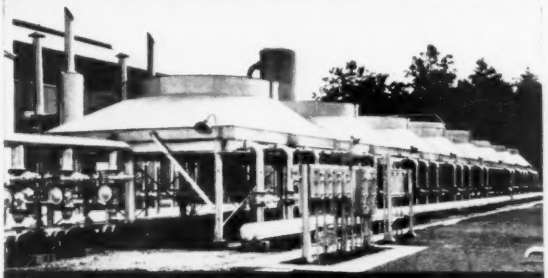

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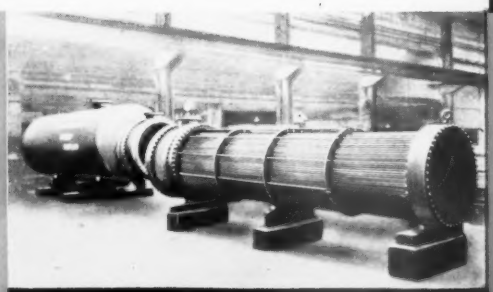

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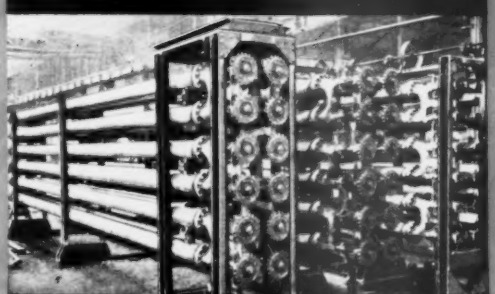

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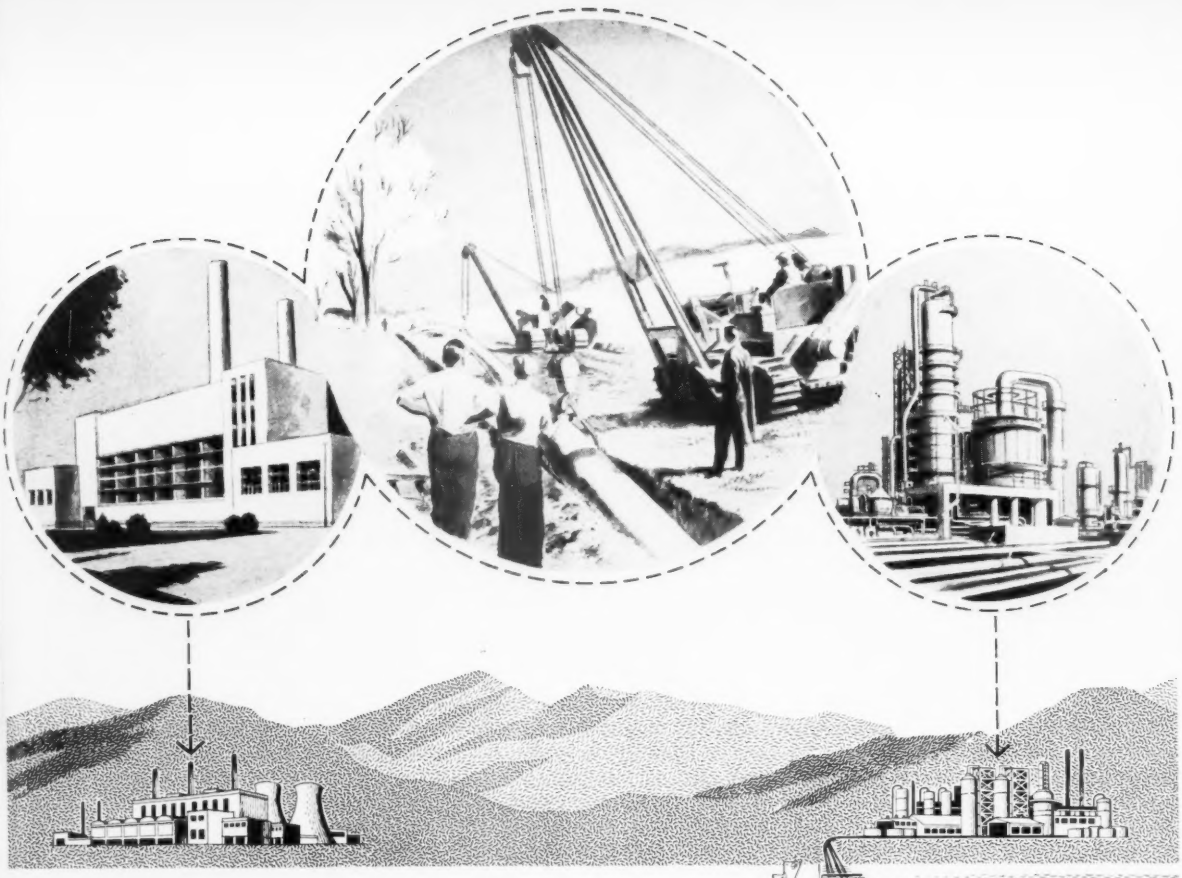

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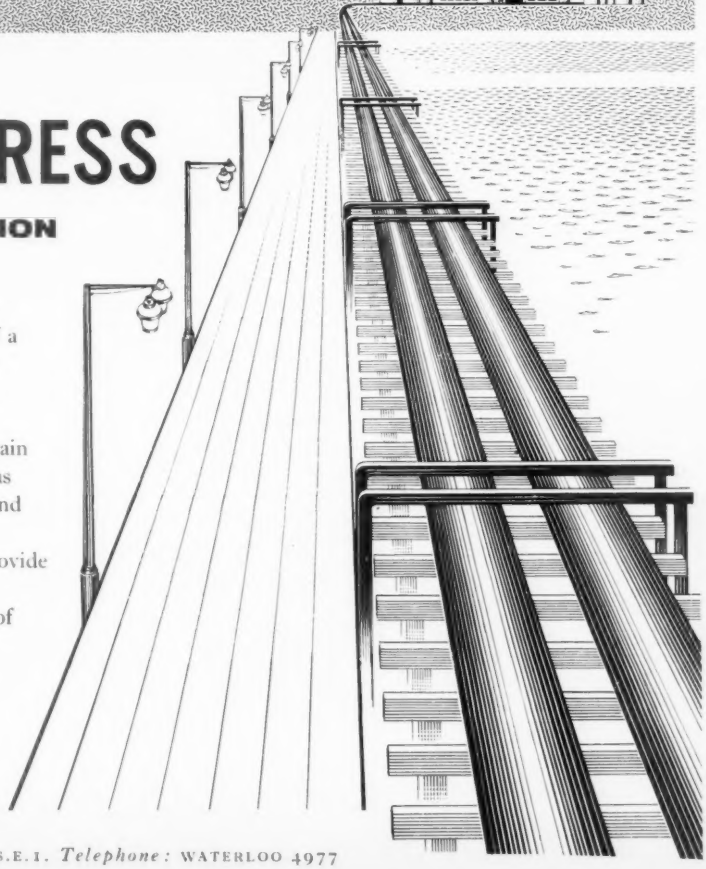

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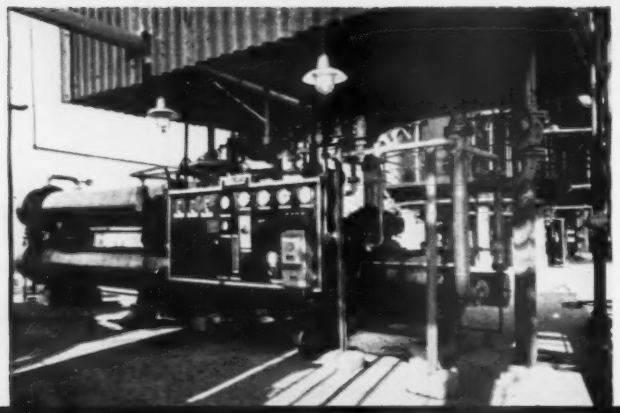

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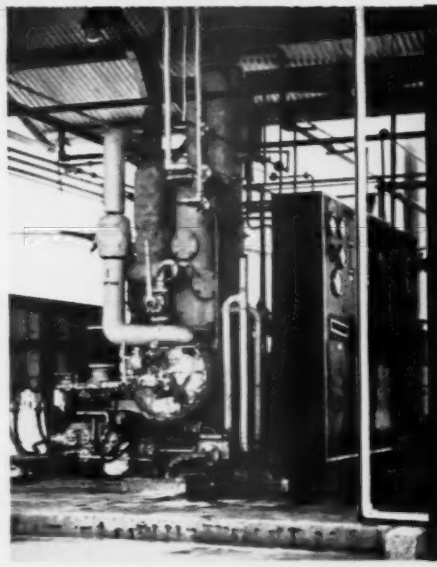

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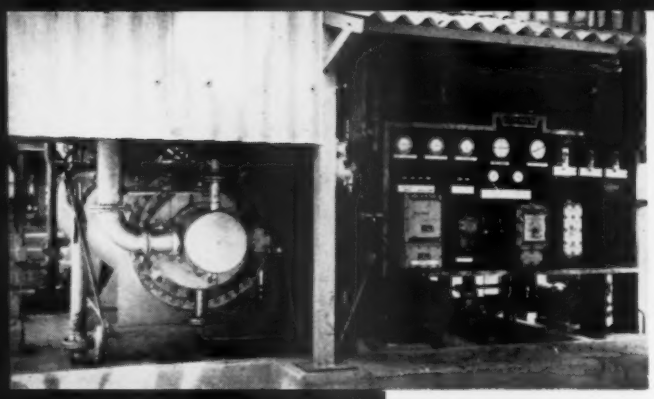

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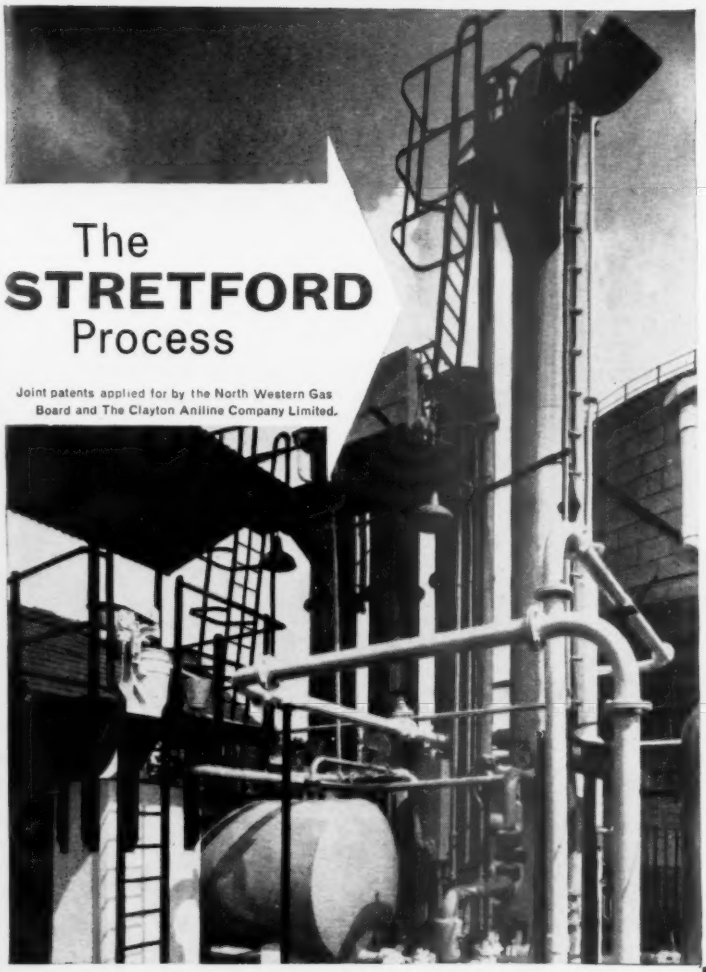
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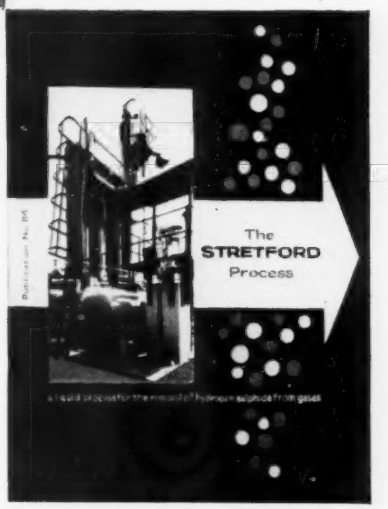

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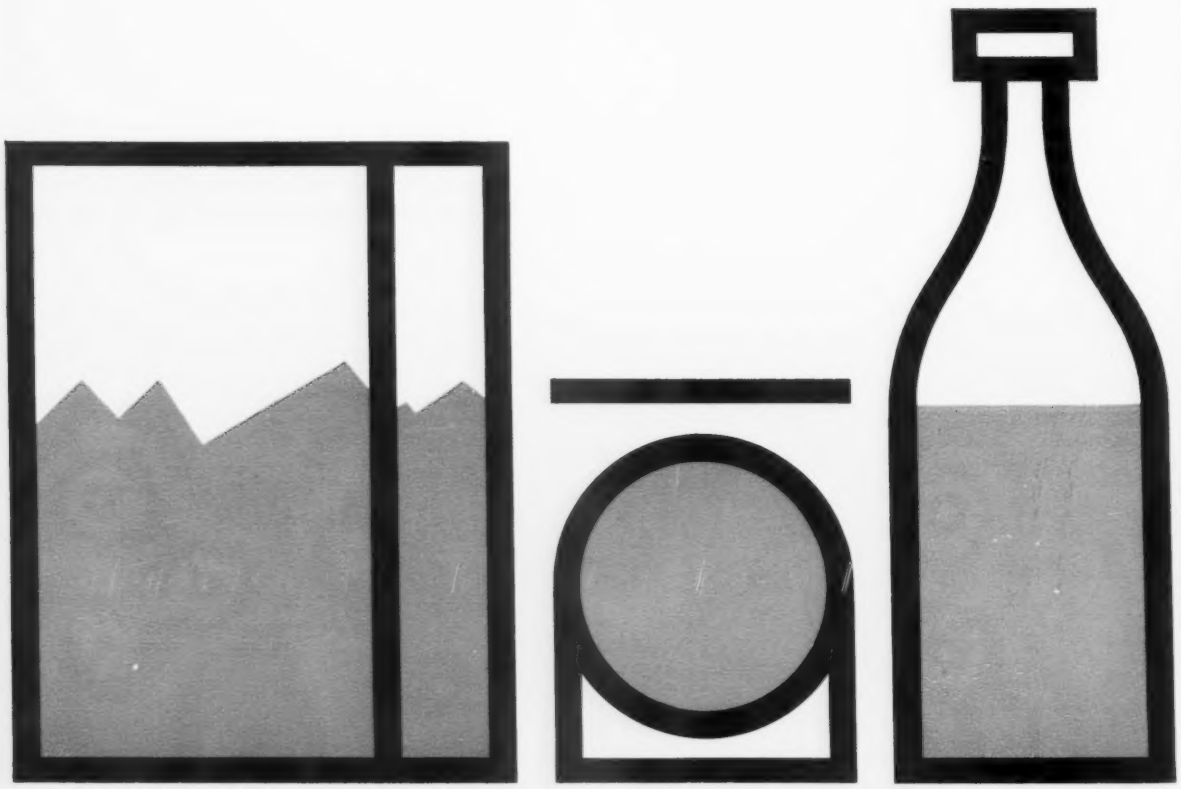

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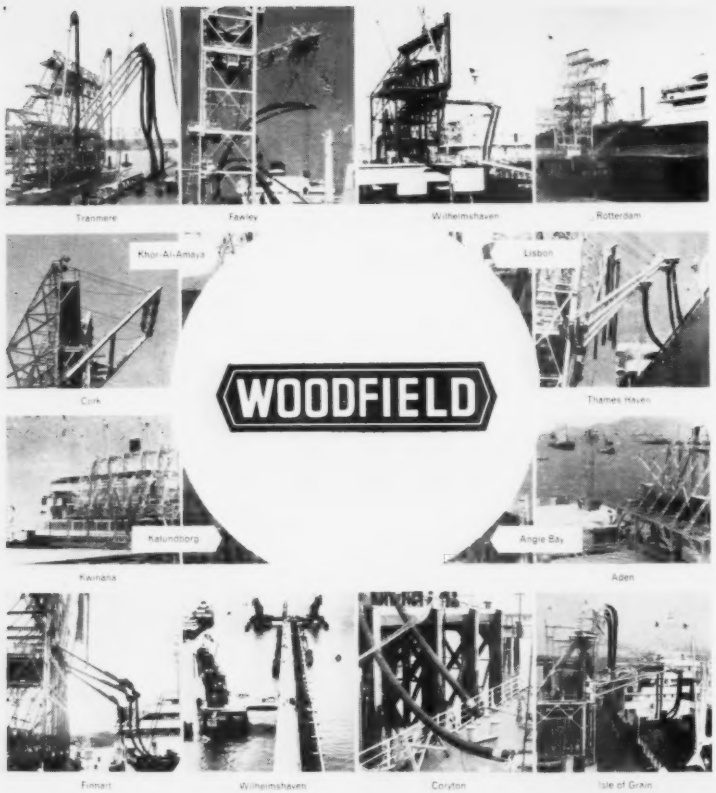

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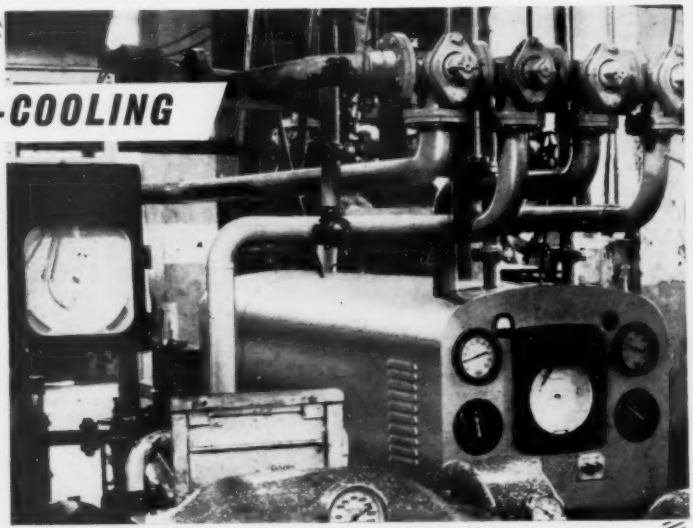

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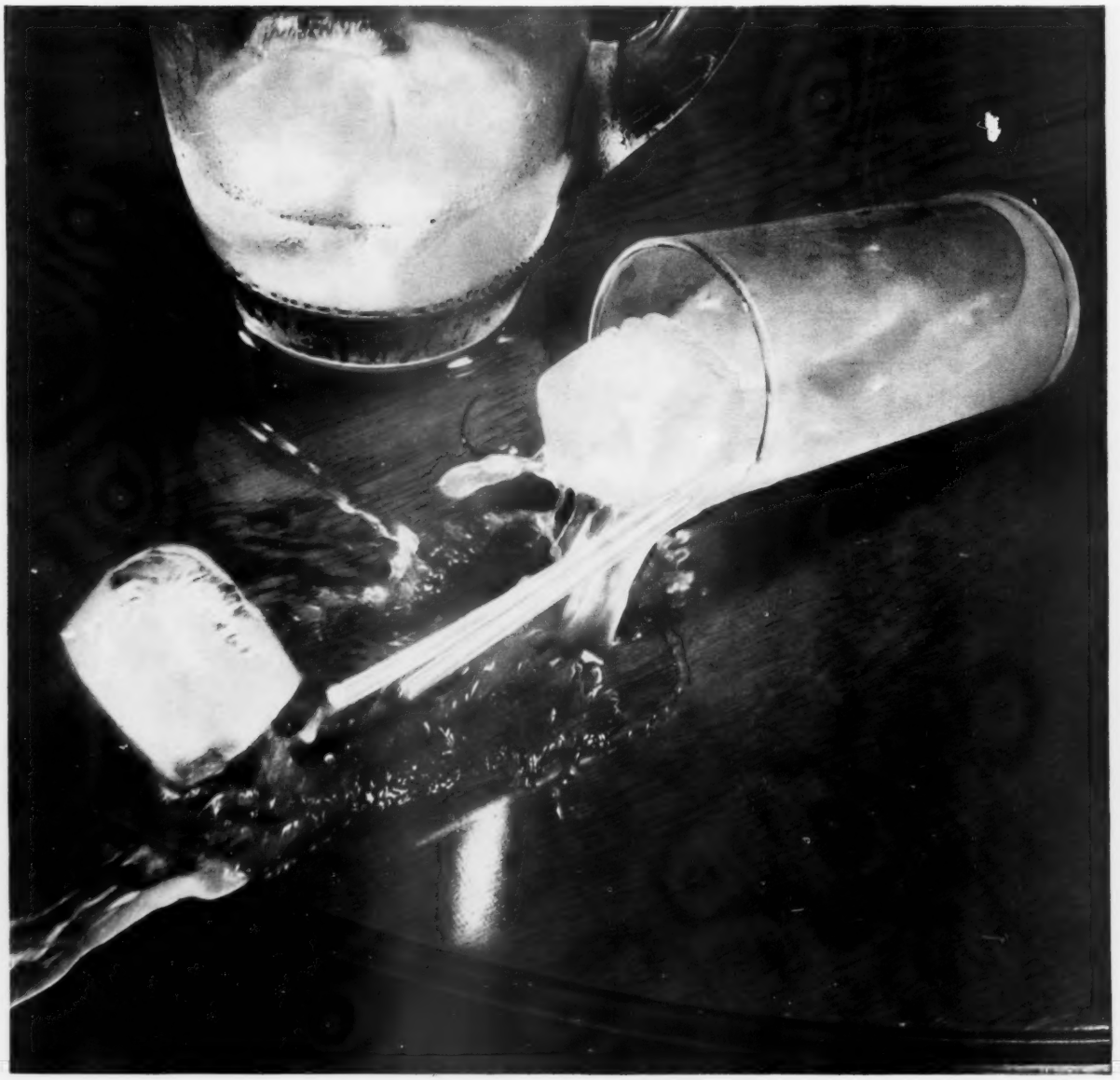

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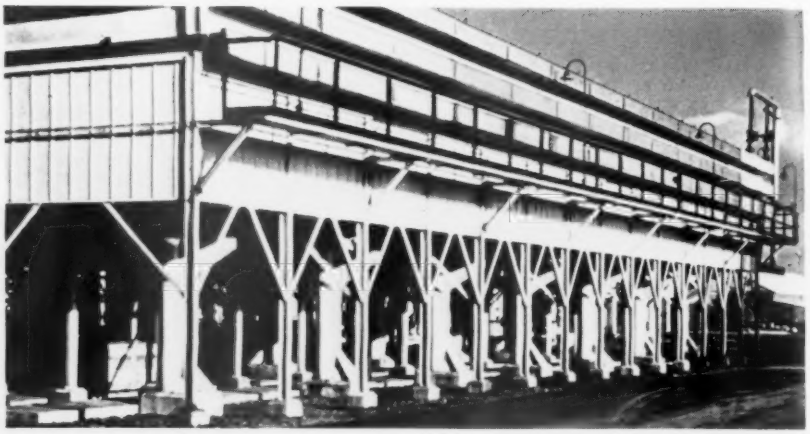

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The above picture shows the largest single air cooled heat exchanger in operation today. This crude bottoms cooler is designed to handle a variety of duties and is typical of the many designs used throughout this installation where there are over 200 miles of tubing adding approximately three-quarters of a billion BTU's to the atmosphere.

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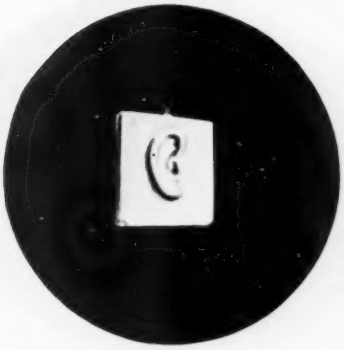
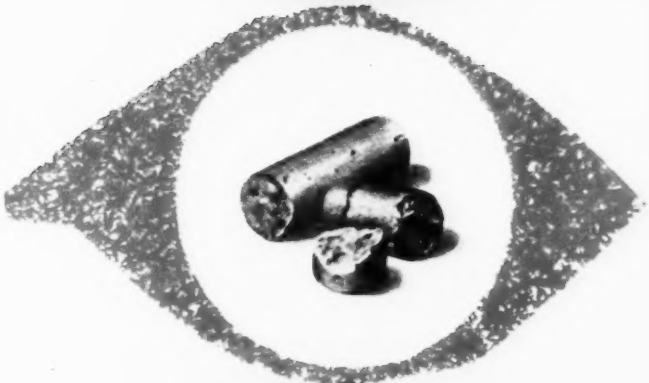

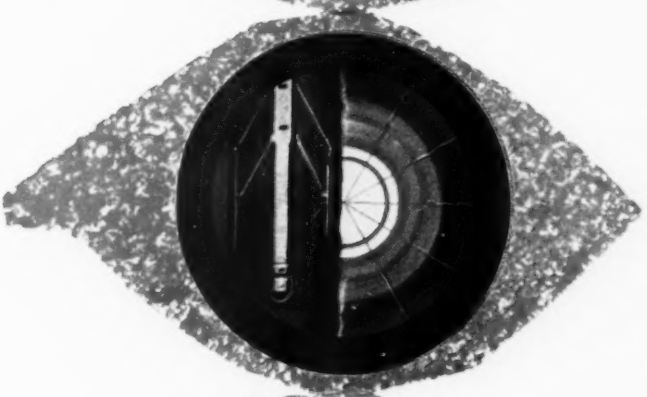

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Advances in Well Logging

By P. THREADGOLD*

The following two papers complete the publishing of the four papers presented at the Symposium on Exploration and Production Methods held on 24 June 1960

Well logging was introduced early in the 1920's, and remained virtually a scientific curiosity for something like 20 years—up to about the mid-1940's. In the interim period Schlumberger were developing a useful practical field instrument, but nothing was done in the real development of the technique. The acceptance of electrical logging as a routine field tool came about with the work of Archie early in the 1940's, when he postulated the basic equations relating the resistivity of porous strata with relative fluid saturations of the strata. From that time, electrical logging became a worthwhile tool, and its use increased.

The next development of any fundamental nature was the work by Doll and Wyllie on the elucidation of the spontaneous potential curve, and I would suggest that from that time we have not really advanced in the resistivity logging field. Certainly there has been, in the last ten years, an enormous number of advances in instrumental techniques; but looked at from a distance, there is nothing fundamentally new in any of them.

Development of Logging Methods

To put these instrumental advances in perspective, to see where we have gone and where we are going in the field of resistivity logging, one can begin with the micro-log, which was the first tool to give anything like a reliable porosity curve. This, at its inception, was hailed as virtually an infallible tool, but, as in most such cases, it was discovered with use that it was not really as infallible as had been hoped. So attention was turned to the focused current logs, in which current was sent into the formations in a pre-determined pattern. In this field development has proceeded virtually to the present day, so that there is now a complete range of resistivity logging tools, from the standard electrical logs with which the whole thing started to the micro-logging tools, and also the focusing tools such as the laterolog and the guard electrode.

The latest advance, outlined in a paper by Schlumberger authors on trends in electrical logging, is in the development of intermediate tools. There were already available the micro tools giving measurements very near to the well bore, and the macro tools measuring deeply into the formation. These were the two extremes, the micro tools measuring the resistance of the zone fully flushed by mud filtrate, and the macro tools—in theory anyway—measuring the resistivity of the strata not affected by the mud filtrate. There was nothing which gave a measurement in between, although under adverse conditions the macro tools measured the effects due to the mud filtrate invaded zone, and did not, in fact, measure what they were supposed to. The new development then is the introduction of what is called a proximity log which gives a penetration of about 20 in. This is combined with an advanced induction tool giving a very deep penetration, and a modification of the laterolog to give a medium investigation. Therefore there are now (at any rate on paper) micro resistivity tools which will measure to a radius of 2 or 3 in outwards from the borehole wall; proximity logs, measuring up to say 20 in radially outwards from the borehole wall; the short laterolog, measuring something of the order of 40 in outwards; and the deep induction log which measures a good way out—as far as can be seen from the little information so far published—something between 12–20 ft in good conditions.

Until about the early 1950's, perhaps the late 1940's, resistivity logging was virtually alone in the field, but about that time the natural gamma ray log was introduced. It remained the only radioactive logging tool until the introduction of the neutron log. The first reference to the possibility of the latter was in a publication by members of Gulf Oil Company. This to my mind represented one of the biggest advances in the whole field, because use was being made of a measurement which was fundamentally different from anything previous. Electrical logs measured resistivity, but what was needed was a log that responded to a completely different formation characteristic.

The neutron tool responds to the power of the hydrogen present in the formation to slow down the fast neutrons; and

* The British Petroleum Co. Ltd.

the measurements taken allow formation properties to be computed. The neutron log is not being used as much as it should, despite the fact that it does represent a basically different form of measurement, and gives an entirely independent check on the conventional resistivity measurements.

For something like four or five years there was no further real advance in logging, although the service companies were continually improving their instrumentation and field methods. Quite recently, however, with the introduction of crystal and photomultiplier techniques for measuring gamma rays and radioactive emissions, it has become possible to obtain more information from radioactive measurements. Here, the first suggestion came from the Atomic Energy Commission at Harwell, who proposed that energy selection techniques, which were beginning to be used in the radioactive field, could be applied to logging. In particular the element chlorine could be identified, giving the basis of a method for detecting the change from salt water into oil-bearing strata. This was proved to be a practical proposition about 1953–54, and again represented quite a significant step forward in techniques.

Since that time there has been a wealth of papers on the application of pulse height analysis, or energy selection, to radioactive measurements down boreholes. There are, in fact, three different things that can be done, and there are hints in the literature that all three are being tackled on an experimental scale at the present moment. The technique mentioned for detecting chlorine uses the gamma rays emitted as a result of the capture of neutrons which have been thermalized by passing through the strata. The second possibility is this—when fast neutrons bombard formations, a gamma ray is emitted as a result of inelastic scatter. This ray is identifiable, and may be used, for example, to distinguish carbon and oxygen, and to measure carbon/oxygen ratios. This could be a very useful technique in oil exploration. Thirdly, it is possible, by irradiating the formations with neutrons from a powerful neutron source, to activate other elements present, which in turn will emit characteristic gamma rays. The main hopes for this particular technique are the possible production of a silicon log, and also of an oxygen log. So there are quite a wealth of possibilities in the radioactive field, all of which have arisen in the last five years.

Continuous Velocity Logging

Recently—as one of the earlier speakers mentioned—we have had the introduction of a third technique, bringing in another completely new principle. This is the acoustic logging tool, or continuous velocity logger (CVL). It was introduced primarily as a geophysical instrument for helping in the elucidation of seismic problems, but has been hailed lately as a petroleum engineering tool, in that under certain well-defined conditions the response can be calibrated in terms of porosity. It is wrong, at this stage, to suggest that the CVL is a porosity tool. It is much wiser to say that it could be a porosity tool, and in some circumstances it can be used as such now.

Recently, in conjunction with the CVL—which has become a real commercial proposition—there has been a suggestion that other acoustic measurements should be made, in particular of acoustic attenuation. Several of the logging concerns, and other organizations, have been interested in this for quite a time, and it is understood to be a practical proposition. My own feeling is that the attenuation log would be much more useful as a petroleum engineering tool than the continuous velocity log. What will probably be developed is a combination of the two curves.

There are quite a number of what can be termed auxiliary tools being developed from time to time. They are very useful tools, which are complementary to the existing logging techniques. In this category are included sidewall samplers, dip meters, and tools of this nature. There have been quite astounding instrumental developments in all these branches of the work over the last 10 years or so.

Of new developments, there has been some published mention of the application of nuclear magnetic measurements as a logging method. This has possibilities, but the published information given is very scanty at the moment, and it is virtually impossible to assess the present stage of development.

The Sources of Development

How have all these developments come about? It is quite obvious, looking back on the past 20 years, that the logging service companies have proved themselves extremely capable of producing very good instruments for taking the required measurements, and of producing very accurate results. At the same time, it must be remembered that virtually nothing happened fundamentally from 1920 until the late 1940's; in fact there was very little advance in new techniques until probably about the mid-fifties. With all due respect to the logging companies, most of the advances in fundamentals, as distinct from operating techniques, have come about as the result of suggestions from either oil company work, or other work outside the logging field. This is something that should be considered quite seriously. There are organizations capable of producing instruments to do what the geophysicist wants, but the latter does not in very many cases state exactly what is required. In fact, these organizations are given very little lead. Where a lead has been given, the development has proceeded at a fantastic rate. When it is considered what logging could do 10 years ago, and what it can do now, there has been a tremendous surge forward in possibilities; and it should be considered whether all these are being thoroughly investigated. My own impression is that we are only just beginning to do it, and the correct relationship is now being established between the logging service company and the user—the oil company—in setting up this balance of field requirements and new ideas.

Future Development in Well Logging

The question now is, where do we go from here? In the resistivity field, there is a similar state of affairs to the one mentioned in the preceding paper on geophysics. A stage has been reached where virtually all the tools that are required are, or will shortly be, available. However, these tools are not being used fully, and too much is based on old concepts with little consideration of further possibilities. We can now obtain a set of measurements which give the variation in conditions going outwards radially from boreholes. At the moment, the only use that is being made of this picture is to correct the resistivity values given by the various tools, and I would suggest that it should be possible to use this information, not as a correction on the macroscopic resistivity tools, but as information in its own right. This was proposed in a paper by F. H. Mann presented in December 1958 to the Canadian Well Logging Society. He suggested that log interpretation could be carried out, not by working on the basic resistivity concepts, but by working on a new concept of what was happening as the mud filtrate invaded the formation

and flushed back the interstitial fluid, whether it be water or oil. It is the sort of idea which should be taken up, and it can be foreseen that in the very near future there may be one combination tool, or one tool alone, which will give a complete continuous picture of resistivity conditions from the borehole wall outwards.

In the radioactive field, the possibilities have been described in the survey of what is going on at the moment. Here there is tremendous scope, but it is limited at the moment by the instrumentation. The fundamental concepts are fairly well established, but the instrumental methods are not yet sufficient to give the information that should be obtainable. Further advances must only be a matter of time; instrumental development and techniques are advancing so fast that what is not possible today could very easily be possible tomorrow. In this respect I would mention a development of Schlumberger and some of the other service companies, of ion accelerator-type neutron sources which work in the laboratory and also, under limited conditions, down the hole. Here is a case where instrumental development will give a tremendous step forward in the possibilities of radioactive logging.

In the acoustic field, it is not quite certain which way development will go. As suggested earlier, acoustic attenuation will definitely become a conventional log. What is not at all certain is what it is going to tell us. It is fairly obvious that additional porosity information will be obtained from attenuation measurements, and there should be information concerning the fluids in the pores. Permeability data—information which to date has not been achieved with any accuracy at all may also be obtained.

Looking at the general picture, it is quite obvious that with the general trend today, computer techniques will almost certainly be applied to well logging. I do not think it is wishful thinking to look forward to a time when there will be logging tools by which a complete survey can be made in two, or maybe three, trips in a hole. The data will be fed into computers at the well-head and the interpretation of the data will be given, instead of having a log produced which has then to be interpreted. The present state of the art does not lend itself to this type of work. At the moment logs are not tailored for processing by computers, but this should not be a subject of too much concern, as it is very easy to design a log to give the information in the form required. Without any doubt whatsoever something of this nature should come in the very near future.

To anyone who is aware of this new attitude which has been growing up in the last five years between the user companies and the service companies, the future looks extremely good. If this paper had been given five years ago, it would have been a great deal more pessimistic—at that time the future looked rather dark. Fortunately the outlook has changed, and one of the main tasks of the user companies is to make sure that the change persists, by playing their part in suggesting new ideas to the people responsible for the development of the actual logging tools.

DISCUSSION

D. Reed (*Schlumberger Well Surveying Corp*): We were certainly very heartened to hear Mr Threadgold's suggestion that the service companies should receive a lot of ideas from the users of the logs, which will accelerate development in the future. Because, after all, that is exactly what everyone in the logging business needs—ideas; and it is very useful to be able to know what is needed and to be able to work on such problems.

If I may mention one or two points on the various logging devices: first, the so-called Grand Slam technique, which is a combination of four resistivity tools having various depths of investigation, is the line of approach which has been suggested at the moment. It is hoped that this will solve the equation, as it were, of several variables with which we have to deal; but unfortunately we still have a few approximations. We must assume some mechanism of invasion of the formation. Generally that is assumed to be an invaded cylinder, which is separated by a sudden change in resistivity, or a transition zone; but some experiments have indicated the existence of an annulus, of saline fluid between the invaded zone and the bridging zone in the case of an oil-bearing formation. This is a complication, and there may be others. After all, what we are trying to do is to find where the oil exists and how much there is of it. To do this we are trying to measure a physical parameter, which is actually nothing to do directly with whether the oil is there or not. Resistivity, magnetic properties, etc, are physical parameters. We need to know the relations between the physical parameters that we measure, and the reality at the bottom of the hole. This is probably where the effort is needed.

I agree that, surprisingly, there are very few new ideas in logging. When the idea of making measurements in a borehole was thought of it was quite possible for the scientists of that time to write down a list of the physical parameters which we might conceivably measure, and this was done. It is easy to think of many things which could possibly be measured, but having measured them, what would they tell us? That is the whole problem, and that is where the fundamental effort is needed.

On the question of recent techniques, I think the present system of radioactivity logging is probably rather a crude approach to a problem which will undoubtedly do more for us if we can investigate it in greater detail. Because the present system is rather a blanket sort of method, we just look and see what happens to all the gamma rays, or all the neutrons; whereas, as Mr Threadgold so lucidly said, if we could analyse what happens and look at them in more detail, we would have very much more information.

The same probably applies to the acoustic logging method, or sonic logging. This is undoubtedly a field in which many advances can be made.

Perhaps the most fruitful field for computing techniques at the moment would be in dip meter computations, because here there is probably a simpler problem. Work is being done in that line to save the many man-hours of computation time, from the many feet of film, which are necessary now that a continuous dip meter capable of great accuracy is used. Not only do we measure the formation dip, but we often have an indication of what appears to be confusing detail, which in fact may probably be information which is useful to the geologist.

One rather interesting thing which has been studied by many companies in the U.S.A. is the transmission of log data. That is, the facsimile transmission of logs from one centre to another, thus helping communications.

P. Threadgold: Personally I would have thought the dip meter was one technique where we did not need computer methods, that is if the dip meter technique is correctly designed. We actually have in mind a dip meter which will give at surface a picture of the resistivity conditions existing over the whole borehole, in fact giving a scan of the borehole wall. It is thought that this is a practical possibility—in fact, it has been virtually proved that it is. If this is so, we should be able to get a dip meter picture which does not need any interpreta- at all. This, I suggest, is better than having a set of records with a wealth of detail, which then have to be analysed by computer techniques. If we are going to apply computer techniques to the logging problem, we must first make sure there is no easier solution. We should not apply them purely because it happens to be the popular thing to do; but undoubtedly they will come, and in the near future.

M. Stephenson (*Bataafse International Petroleum Mij*): Has Mr Threadgold any information or comments on what might be called systematic discrepancies between formation factors or parameters as measured in the laboratory, and as indicated underground? And if so, in which direction, which trends, have such differences been noted?

P. Threadgold: This is a side of the interpretation problem which I must admit I have not gone into in any great detail, but there have been reports in published material of such systematic differences between factors measured by logging tools, and the same factors—or what are reported to be the same—measured on samples in the laboratory. I am not a bit surprised that this happens, for however hard you try the conditions of a core in the laboratory can never be identical to its condition when it was underground. In cutting the core and bringing it to the surface you are bound to alter its physical properties to a greater or lesser extent. Your porosity is

bound to change, probably slightly, purely due to the pressure changes undergone and to the laboratory techniques in measurement.

This is a very big problem, because we have in the limit to calibrate our logs against information obtained. Most of the logs are capable of a theoretical analysis which will predict the sort of response which should be obtained; but, in essence, this still has to be checked against cores or some other independent check. However careful we are, we are bound to find systematic errors coming in. The ultimate check in accuracy of any log interpretation, or any method of computation of conditions down the hole, can only come about as a result of long-term experience with the particular hole in question.

R. H. W. Hamilton (*Iraq Petroleum Co. Ltd*): We are interested in that particular aspect ourselves, and have completely cored some wells, and tested them at regular intervals over their full length—perhaps every 20 ft over 400 ft. They were completely logged as well. One does therefore have the three aspects to compare, and we are rather hopeful that perhaps something can be found out on the lines of the question that Mr Stephenson was mentioning. However, it is an expensive procedure, and it can only be done on a few selected wells.

P. Threadgold: There is one very big question which is not answered. You measure certain formation characteristics on cores, for example porosity. You also measure porosity with a set of logs, probably two or three different logs which give a porosity figure—micro, neutron, gamma, sonic, and so on—and you get two different answers. Who is going to say which answer is correct?

R. H. W. Hamilton: But you do have the test result of the well to give you some support, from one side or the other.

P. Threadgold: Yes, I think this is the answer, that you have to examine your evidence in the long-term light of what happens to the well afterwards, and not just purely weigh two independent pieces of evidence against one another.

D. A. Tanfield (*National Coal Board*): In discussing nuclear reactions, Mr Threadgold did not mention the gamma-gamma reaction. Some work has been done on this. Has it been found wanting as compared to neutron gamma, and has it been abandoned? I am rather interested in this because the Coal Board is using a gamma-gamma reaction, not for well logging but for another similar process.

In referring to neutron-induced gamma-activity, you mention the possibility of logging for oxygen and silica, and I wondered whether this process would also be suitable for logging for aluminium, because this has the very convenient decay time of 2½ minutes, and would be reasonably easily identified by induced gamma of 1·7 mev. This may not be so important for oil geologists, but it is extremely important to coal geologists.

On the question of reactions, or phenomena, that might have been mentioned or used, I wonder if Mr Threadgold knows if anyone has considered whether any information might be obtained from absorption of microwaves. Techniques developed for radar could be transferred perfectly simply to probes, and I wondered whether there is anything to be gained there.

P. Threadgold: The fact that I missed out the gamma-gamma density log was quite an oversight on my part. The gamma-gamma log for measuring formation density has received quite a deal of publicity. There is no doubt that some of the results obtained with it look extremely good. Personally I would rather sit on the fence on this one. We have never actually tried it ourselves, and so I am talking from secondhand knowledge, but the theoretical background to the gamma-gamma density log is not quite so good as some of the literature would have us believe. Nevertheless, it has given extremely good results. Here again I think it is a question of using the tool under proper conditions, and at the moment I would hate to have to say what these proper conditions are.

On the question of neutron activation, it is quite correct that aluminium is one of the elements that can reasonably easily be identified by this method, and it has been shown to be a practical possibility. This is not so important to the oil geologist as you suggest, because aluminium is quite a common constituent in clays, which under certain conditions can become quite important in the oilfield. The three elements which can be identified on a practical scale by neutron activation are silicon, aluminium, and oxygen.

The question of absorption of microwaves is a very interesting one, and unfortunately it is a very far-reaching one. I would say that if we go up to the microwave field, we shall not get very far—and this is literally true, because absorption becomes so high as the frequency goes up that the wave is virtually attenuated out of existence before it gets anywhere. However, if we come down the scale a little and consider absorption at high frequencies, going up way above any frequency we are using in conventional logging, I think there we have a very good possibility of taking logs, using the same geometrical electrode set-up, but using different frequencies and measuring the changes in absorption with frequency. As far as I am aware very few people have done anything with it yet. Using existing microwave technique, I think what we would be trying to measure would be so very badly damped out that we would see nothing further than maybe a ½-in or 1-in from the borehole wall, which in any case is taken up by mud cake.

M. Stephenson: We did a little work on the last item, and I would like to corroborate that when you use microwaves the absorption gets so high that you hardly get a significant or useful penetration. When you use the longer waves, you get the penetration, but you get such a rough, coarse picture, so that it did not seem to be particularly promising.

Mr Pittaway (*Birmingham University*): I would like to ask why there has been no mention of temperature surveys in the paper. Reverting to the first paper ever written on thermal logging, one of the authors said that it was his opinion then that this was going to be a most important borehole tool. A temperature log is the only dynamic survey that exists today. I feel however that this is possibly an example of where a measurement is made—in this case of temperature—and then nobody knows what it tells us; and so it is generally ignored. Temperature surveys are now used only for final completions but where fluids are moving in a borehole there are other potential uses.

Secondly, Mr Threadgold did not mention anything about tailored muds. I feel that such a lot could be done to improve logging interpretation by paying a great deal more attention to mud. It is a most important point, which should be emphasized in any opinion on what the future will be.

P. Threadgold: The question of temperature surveys is one that has come completely out of the blue. As you mention, a temperature measurement or a temperature log is a very useful auxiliary tool for locating cement tops, tracing fluid flow, and in some cases getting a quantitative estimate of fluid flow. The use of temperature as a log in its own right has been carried out many times—I think the Coal Board use a temperature log from the point of view of geological correlation, and identification. Quantitatively I think there would be considerable difficulties in interpretation; but there may well be some truth in what you say, that we are not quite sure what it means when we have got it. To begin with, you have conditions of non-equilibrium when you drill the hole; your temperature conditions are completely upset anyway by the pure mechanical action of the circulating mud. You can get a certain amount of information from the temperature log when the temperature of the mud has come into thermal equilibrium with the surrounding formations. I must admit, however, that there has been very little work done on this, and any work would be quite intensive, and would take quite a long time. I have a feeling that the results would not justify the means.

On the question of tailored muds, I am with you all along the line, but I deliberately did not mention them because they were a little off the main scope of the discussion. As far as resistivity logging is concerned, certainly, the quality of the logs you get, the accuracy of the logs, and by imputation therefore the quality and accuracy of your interpretation, depends almost entirely upon the condition of the mud. It is possible to run a suite of logs in a hole with completely the wrong mud in it and get no information out of it whatsoever. This is a bad case, and it rarely happens, but it has happened. I entirely agree that if in the field more attention was paid to tailoring the mud to the particular suite of logs we should get a lot more reliable information from them.

D. Reed: Some work has been done with temperature surveys, in a quantitative way, as a method of estimating gas production by the cooling effect. I know of that, but I do not know of the conclusions that were drawn from this technique as a logging method. I would be interested in what the previous speaker would think would be a desirable accuracy for temperature measurements.

Mr Pittaway: I say that the temperature survey is the Cinderella survey of today. The tool that Schlumberger offers the market is a most remarkable one, but I am sure it is not used to anywhere near its real ability. Provided there is a great kick up at the top of the cement, something like 15°, everybody is happy. Only on rare occasions—obviously because of the time consumed—have I seen temperature surveys run during the attainment of equilibrium with the formations, or any attempts made to evaluate thermal conductivities of formations, which I am sure is yet another parameter of the borehole that could give a great deal of information. As Mr

Threadgold said, any work that is done on this is going to be very lengthy and no one knows what the results are going to be at the end of it. I would disagree that they would not be worthwhile; I think they could be very worthwhile, but it is going to mean a tremendous effort by someone.

D. A. Tanfield: Mr Threadgold mentioned that the Coal Board has made some use of thermal logs. In fact, most of the work that we have done, apart from some bottom hole measurements carried out in the East Midlands Division, has been directed at trying to find out the thermal gradient from the point of view of ventilation and working conditions. The difficulties are as Mr Threadgold has indicated, that in fact you cannot get any information that you can relate to anything at all unless you make a time study and then extrapolate. Unless you are prepared to make observations only at the bottom of the hole, and then extrapolate as you go down, this always means keeping the hole standing. What we have to do in fact is to make measurements at weekends when the holes have been standing. By this means we have been able to get this series of conductivities, but they have been rather crude, although we can distinguish easily the change in thermal gradient between permeable and other rocks, where there is a substantial change. We do not, however, get the detail that shows the change in conductivity of, for instance, a coal seam, as compared to shale or sandstone. Also this whole business is very much complicated in the parts of Britain where it has been applied, because of thermal transport by moving water. This is a very serious complication.

N. L. Falcon (*British Petroleum Co. Ltd*): We are all interested in fissures, etc. What can you do to help us in this?

P. Threadgold: There are several possibilities, but they are all rather looking ahead a little. It may be possible to identify and locate fissures by the resistivity method using very finely focused beams of current. This is a possibility, but whether it will ever be practical or not remains to be seen. You can locate fissures if you have fluid flow, either into or out from the fissure. This has been done. It is fairly time consuming, and the operation has to be very carefully controlled.

The other possibility which will locate a single fissure or a system of fissures *en masse* is the use of sonic or acoustic logs. The sonic log does respond to fissures. From our point of view, if we are trying to use it to estimate porosity, the effect of fissures on the sonic log is a bad one. Nevertheless, I see no reason why this apparent bad effect should not be put to good use. Here it depends on what your matrix system is, whether you have a single fissure or whether you have a system. I think the sonic log, with development, should be able to tell you what sort of system you have; in fact it should be able to tell you whether your porosity is inter-granular or whether it is a fissure system. Whether it ever will do this in practice I do not know, but I can see no reason why not.

Partial Removal of H_2S from Crude Oil by Stripping with Natural Gas

By **T. R. SHIPSTER***

The limitations placed on the quantities of H_2S which are allowed in crude oils imported into countries where they are refined makes it necessary to subject most sour crudes to some specialized form of treatment before exporting them. In addition to the usual methods of separating dissolved gas from these crudes there are a number of methods available for removing the H_2S which remains, and it is the one employing stripping with a natural hydrocarbon gas at ambient temperatures that is the subject of this paper.

About three years ago a plant capable of processing about 200,000 bd of crude was commissioned and has been on stream for most of the time since then. In the plant, a simplified flow chart of which is given in Fig 1, the H_2S is removed from the incoming cold stream of crude by a stream of sweet hydrocarbon gas flowing counter-current to the oil. The operation is carried out at ambient temperature and nominally at atmospheric pressure, and consequently is simple to operate and makes little demand on services. Stripping by means of the counter-current flow of liquids and gases is a common chemical engineering principle, but its application to the removal of H_2S from crude oil in this particular way, had, up until this time, so far as was known, not been given much attention. The probable service requirements and maintenance costs of such a process added to its attraction as a method of crude oil sweetening. Before building the plant the absence of any practical data and doubts as to the plate efficiency at which a bubble tower would operate at ambient temperatures, and what effect the viscosity of the crude might have on the proposed process, led to a series of pilot tests being carried out. These tests confirmed in practice what calculation had shown to be possible in theory, and a comparison of the two sets of results matched each other sufficiently accurately for a large-scale unit to be designed.

The unit installed consists of two columns, each with a maximum design capacity of 105,000 bd of crude oil. These columns, which operate in parallel, are 78 ft high and 12 ft in diameter, and contain 24 four-pass bubble-cap trays. Crude oil is fed on to the top tray by a single charge pump and the stripped crude is discharged from the base of the tower by a similar product pump into a flow tank. Sweet gas, which is available at pressure, is divided into two streams on arrival at the unit, and enters each column under the bottom tray. After leaving the top tray the sour effluent gas passes through a crinkle wire mesh mist extractor which removes any entrained liquids. Theoretical considerations of the stripping process demonstrated that, in order to minimize the quantities of gas required, the lowest possible working pressure should be used and, in fact, the unit operates at a column base pressure of from 2–4 psig and a column top pressure of about 1·0 psig. There is no fan or blower in the gas outlet line, but the low back pressure has been achieved by passing the gas through a 16-in line to a nearby flare.

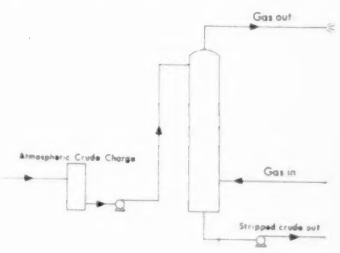


Fig 1

* Iraq Petroleum Company Ltd.

Total removal of H_2S from the crude is not required, and the majority can be extracted using comparatively few plates. It was assumed that 4 theoretical plates would be sufficient to reduce the H_2S content of the crude to an acceptable limit. The 24-tray design assumed that the overall plate efficiency would not be less than 16·67 per cent. An examination of the discrepancies between actual and calculated stripping factors shows that these columns do actually operate at an approximate efficiency of 16.5 per cent with respect to H_2S.

The stripping columns are equipped with vapour and liquid sampling points at half-way and quarter-way positions so that it is possible to examine the intermediate compositions of oil and gas. In this way a series of material balances could be constructed to show the progress of the two phases throughout the column. Fig 2 gives some indication of the rate of stripping of H_2S from the oil as it flows down the column.

The pressure at which stripping is carried out affects the operation in that, as pressure increases the relative volatility of propanes, and heavier components, with respect to H_2S, increases and fractionation becomes poorer. For a given degree of sweetening the quantities of gas required increase with pressure, being approximately proportional to the absolute pressure. The net result, after reduction to atmospheric pressure, for a given degree of sweetening is a product with smaller quantities of butanes and pentanes in it.

The effect of stripping at higher than ambient temperatures affects the operation in that, although smaller quantities of gas are required for a given degree of sweetening, the increases in relative volatilities and increase in temperature result in a finished product with lower gravity and vapour pressure than would be produced at ambient temperatures.

Any sweet gas can be used for the removal of H_2S (see Fig 3) from crude providing it is available in sufficient quantities. However, if other considerations such as vapour pressure, gravity, and light end content of the sweetened crude have to be taken into account a gas which is best able to meet such requirements must be used. For instance, a dry gas of gravity 0·67 containing 95 per cent methane and ethane and 5 per cent of propane and heavier removes about 95 per cent of the H_2S present in the sour crude for a GOR of about 45 scf/brl. In doing this for the oil in question, the reduction in H_2S is accompanied by a loss in the lighter components equivalent to a gravity loss of about 0·8° API, and an RVP reduction of about 5·5 psi. For a gas of gravity 0·95 containing approximately 75 per cent methane and ethane and 25 per cent propane and heavier, about 55 scf/brl is required to achieve the same degree of sweetening, and the accompanying loss in gravity is reduced to about 0·3° API, with a reduction in RVP of about 4·0 psi.

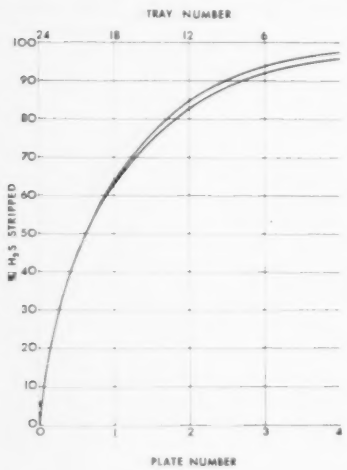


Fig 2

It would be possible to carry out the sweetening operation with a gas re-cycled through the unit by way of a gas sweetening plant which removes only the stripped H_2S. Such an operation would leave a sweetened product with, for all practical purposes, the same properties as that entering the sweetening unit. Carrying this a step further a stripping gas could be used in which absorption of light components would bring about an increase of gravity and RVP. Finally, depending on the degree of sweetening required, it is possible to remove substantial quantities of H_2S from crude oil with a gas which itself contains H_2S, although the degree of sweetening that can be achieved in this case is dependent on the relative concentrations of H_2S in oil and gas. In fact, there is a small unit consisting of a packed tower processing about 6000 bd and removing from 75–80 per cent of the H_2S present with a gas containing about 0·9 per cent H_2S.

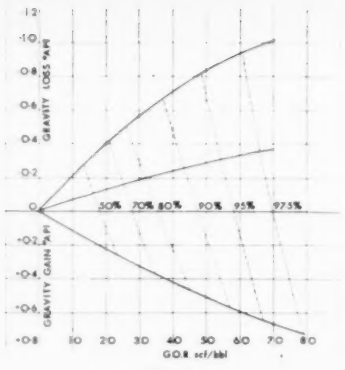


Fig 3

The satisfactory operation of these plants has clearly demonstrated the soundness of this process as a means of removing H_2S from crude. They are comparatively simple in design and operation, and are especially attractive in areas where services are limited and expensive.

DISCUSSION

F. C. Thomas (*British Petroleum Co. Ltd*): That the H_2S in crude oil is a nuisance is perhaps obvious in a residential area around a refinery but what is not appreciated is the greater nuisance it is to the producer who has to pay for its removal. Mr Shipster has said that H_2S is removed in the usual stabilization processes in the field; for example, the usual multi-stage separator system will remove 75–85 per cent of the H_2S present in a reservoir crude oil. But it is when we wish to remove the extra 15 or 25 per cent that the trouble really arises. One could, I suppose, raise the proportion lost by ordinary separation by increasing the temperature at the last stage in separation, or by putting a vacuum on the last stage. But the penalty for doing that would be a loss of light ends, and one cannot achieve the extra advantage by such means without exceeding, say, 1 per cent loss in light ends from the crude oil. So one has to put in an extra degree of fractionation to avoid these losses, and the process described by Mr Shipster does just that. That to my mind is the simplest and most economical way of doing it. The capital cost, I think, is relatively low. It has the advantage of easy maintenance, and a simplicity of operation, and in that connexion, seems a plant which lends itself very well to automatic control and complete automation. I would ask Mr Shipster whether consideration has been given to complete automation of this plant, and whether automatic control is carried out?

There are one or two points on the efficiency of the separation which I would like to raise. Two problems have come to light in the initial design stages: first, what is the plate efficiency one can assume? I think Mr Shipster mentioned that data and literature suggests that it might well be less than 10 per cent in a process of this nature, largely on account of the high viscosity of the crude oil. The second problem is how reliable are equilibrium vaporization data for H_2S when applied to the very low concentrations encountered in this process?

It seems that the figure of 16·5 per cent found mainly by plant measurements, may be fortuitous in so far as an assumption for equilibrium constants of H_2S have to be made, and the evidence suggests, at least as far as very low concentrations are concerned, that equilibrium constants and K values may be much higher

than they normally are. So that if a different value had been used, a much larger plate efficiency might perhaps have been found.

I would like to know whether it has been possible to check that point by the balance on hydrocarbons, by calculation using the hydrocarbons rather than the H_2S?

Dealing again with the practical efficiency of the unit, I believe gas velocities are very low in these columns, and no doubt extra thought had to be given to tray design. I would like to know whether there is any marked change in efficiency with reduced throughput of crude oil, and what is the flexibility as regards throughput?

As far as it goes, it would appear that this is the answer to everybody's prayer when it comes to a relatively cheap method of removing H_2S. In other words, what are the disadvantages, if any? Mr Shipster says that there may be a loss of 0·8 API gravity on the oil, which may be one per cent loss of light ends. Is this a disadvantage? In my own view, it may not be. He mentioned that it is largely propanes, plus butanes, and a small amount of pentane. I question whether the refineries would really need that extra recovery of its light ends, particularly in view of the diversity of catalytic processes now obtainable, which in themselves are main producers of propane and butane.

T. R. Shipster: Regarding making these stripping plants fully automatic, as far as I know, we certainly have not gone that far yet; although I would agree that this is a process that lends itself to it particularly well.

As far as the efficiency of the plant with regard to the separation of the other hydrocarbons in the crude is concerned, I have made some rough calculations, not involving the individual hydrocarbons, but calculating the gravity loss on each tray as you go down the column, and we have a number of measurements from this in the intermediate sampling points that I talked about; and preliminary investigation shows that they do agree fairly well. But I have not reached the stage with these calculations yet—they are very long and tedious ones—where one could definitely say that the efficiency of separation of, say, propanes, is either better or equal to H_2S.

Regarding the drop in the efficiency of separation with throughput in the columns, there has been much work carried out in the field on this, and it was shown that although the unit is designed for a maximum capacity of 105,000 bd, once you get down to below 60,000 bd the efficiency starts to drop off. It is shown by the fluctuating H_2S contents of the sweetened product obtained from the unit. Similarly, tests of minimum gas/oil ratio that could be used were carried out, and the unit was designed for maximum gas/oil ratio of something like 90 cu ft/brl. We, in fact, use in the neighbourhood of 50 cu ft/brl. There again, when you get down to 25 cu ft/brl the efficiency starts dropping off badly.

Dr C. Bouman (*Bataafse International Petroleum Mij*): Mr Shipster's paper is a very valuable contribution, especially in regard to the plate efficiency of high viscosity oil. Equilibrium constants might be different from what we think, so it is possible that the plate efficiency may vary in determining equilibrium constants for each component.

I was unable to find any explanation for the high plate efficiency for these very unfavourable conditions. Mr Shipster's possible explanation that plate efficiencies are highly unexpected could, first, be that available literature was quite insufficient; secondly, it could be that a special tray design of this column has been an important factor. I would like to hear if the matter of tray designs has anything of interest.

T. R. Shipster: Dr Bouman has asked me a question which I am not really qualified to answer. The plant was designed by an outside firm, and they simply guaranteed that it would handle so much liquid, and so much gas, and we adhered to that guarantee, and have not gone any further into the design of the trays. I believe that these four pass trays, as they call them now, are fairly common, but other than that, it is simply the usual bubble cap tray that is found in any ordinary fractionating plant.

R. Quartano (*Petroleum Times*): Is this the most economical column design, or were there some over-riding factors. Could not what is, from a refining angle, a rather remarkably low tray efficiency have been increased sufficiently to allow the addition of a few more trays. And why were double trays chosen instead of some other form which would be cheaper to install and maintain.

T. R. Shipster: As I said, we simply accepted the design that was given to us—the unit as a whole and the trays in particular.

E. C. Masterson (*Kuwait Oil Co. Ltd*): How much H_2S was in the crude originally? You mention removing 85 to 95 per cent, and it is a bit like these Russian figures where they claim increased production by 50 per cent.

T. R. Shipster: There is a seasonal variation, but it varies between roughly 0·085 and 0·125 per cent by weight.

* * *

INTERNATIONAL SYNTHETIC RUBBER SYMPOSIUM

The large increases in the growth of world rubber consumption over the last few years were amply highlighted at the Second International Synthetic Rubber Symposium which was held in London recently at Church House, Westminster. In his speech at the opening ceremony the Rt Hon. Viscount Hailsham, Minister of Science, said that in a wide range synthetics can successfully complement the natural products. This had already happened in the field of natural fibres and synthetic rubbers could well do so in their own field. The development of combinations, or of new uses for both synthetic and natural rubbers, might well depend upon meetings such as the Symposium.

It was forecast by G. E. Beharrell, chairman of the Dunlop Rubber Company, that by 1970 the world consumption of natural and synthetic rubber might well approach 5 million tons. The change that was taking place in the relative shares of the two types of rubber was shown by the fact that whereas in 1956 some 38 per cent of world consumption was synthetic, this year the proportion was expected to rise to over 45 per cent. Part of the explanation for this, it was said, lay in the increased number of synthetic rubber producers. In Great Britain alone synthetic rubber production has risen from 1000 tons in 1957 to a probable 85,000 tons by the end of the current year, when the International Synthetic Rubber Company's capacity would be about 100,000 tons.

Current research which could considerably raise the consumption of synthetic rubber over the next decade included that now in progress on *cis*-polybutadiene and *cis*-polyisoprene. These both had some chance of replacing natural rubber under conditions where low-heat build-up was required, such as in large tyres for commercial vehicles.

A total of 19 papers was presented at the symposium, the subjects covering such matters as advances in anionic polymerization, polyisoprene rubber, rhéological properties of cis-polybutadiene and other polymers, the carbon black structure effects in synthetic rubbers, and preparation and properties of chlorobutyl.

The symposium, which was organized by *Rubber and Plastics Age*, Gaywood House, Great Peter Street, London, S.W.1 also included an international rubber exhibition at which the products of some 100 companies from Western Europe and the U.S.A. were featured.

Institute of Petroleum Awards

The Council of the Institute has made the following awards, and the date of their presentation will be announced later:

THE EASTLAKE MEDAL

To George Sell, F.Inst.Pet.

His first association with the Institute was at the time of its foundation as the Institution of Petroleum Technologists in 1913. At that time he was in the employ of Messrs Redwood and Eastlake, the founders of the Institute, and was called upon for clerical and similar assistance. Following the first world war, he became a part-time officer of the Institute in 1923 as associate editor, and in 1925 also took on the secretaryship of the Standardization Committee and its sub-committees. Prior to that he had played a considerable part in the preparation and production of the first edition of "Standard Methods for Testing Petroleum and Its Products" in 1924.

George Sell

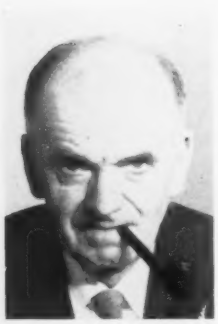
In 1930, George Sell entered the full-time service of the Institute in the same two capacities and a year later added to them the post of librarian. He occupied those three posts until 1936, and in that period was also assistant editor and assistant secretary of the First World Petroleum Congress held in London in 1933.

From the beginning of 1937 until the outbreak of the second world war he was associate editor of *Petroleum Times*. During the war he was with the Petroleum Department of the Board of Trade (later the Ministry of Fuel and Power), first as a rationing officer and later as an organization and methods officer. In January 1945 he returned to *Petroleum Times* and in March 1946 rejoined the Institute as editor of its publications. In that position, George Sell has been responsible for all IP publications and for the development of the *IP Review* from its inception in 1947 to its present eminence.

He retires from the editorship at the end of March 1961.

THE HONORARY FELLOWSHIP

To Professor F. H. Garner, O.B.E., Ph.D., F.R.I.C., F.Inst.Pet.



Prof. F. H. Garner

In 1930 he was first elected to the Council of the Institute and seven years later became a vice-president. In 1944 he was elected the president and occupied the chair for the two sessions 1944–5 and 1945–6.

Professor Garner has always been interested and active in the scientific activities of the Institute. Thus, in 1937 he was appointed honorary associate editor, during the honorary editorship of Dr A. E. Dunstan, who he succeeded as honorary editor in 1946. He retained the latter post until 1954 and during that period saw the start of the *IP Review* and played an important part in the formulation of its policy.

In the field of standardization Professor Garner has also rendered considerable service to the Institute. Not only has he served as chairman or member of various sub-committees and panels, but from 1939 until 1945 he was chairman of the main Standardization Committee. He also served on the Research Committee and other IP committees.

At the end of September he retired from the Chair of Chemical Engineering at Birmingham University, a chair which he had occupied since 1942. His interest in the academic field is reflected in the subject of his Redwood lecture—"The training of a technologist"—which he delivered to the Institute when awarded its Redwood Medal in 1951.

As well as to the Institute, Professor Garner has given considerable scientific service to the country. For this he was awarded an O.B.E. in 1943 and the U.S. Medal of Freedom, Silver Palm, in 1947.

Professor Garner will continue as a member of the Publications Committee and of its Papers Sub-Committee.

SUB-PANEL CHAIRMAN RETIRES

The Engine Tests of Motor and Aviation Fuels CFR Operator's Sub-Panel STFIA interrupted their meeting at Esso Research Ltd, Abingdon on 29 September for the presentation of a cigarette lighter to **A. C. Britton,** Esso Petroleum Company Ltd, Technical Sales Department, by J. R. D. McKenzie-Edwards, Shell Refining Company Ltd, Heysham, who succeeds him as Sub-Panel chairman. Mr Britton was one of the founder members of the CFR Operator's Working Group, and had been secretary from 1949 to 1951 and chairman from 1951 to 1959. His association with CFR engine tests dates back to 1927.

Around the Branches

ABADAN, BAHRAIN, ESSEX, FAWLEY, KUWAIT, LONDON, NORTHERN, SCOTTISH, SOUTH-EASTERN, SOUTH WALES, STANLOW, TRINIDAD, YORKSHIRE

Northern Branch

The first meeting of the Northern Branch of the 1960–61 session was held in the Engineers Club, Manchester, on 18 October when S. Shagrah of Shell-Mex and B.P. Ltd read a paper entitled "The Bulk Transportation of Petroleum".

The scope of the talk was restricted to the distribution of petroleum and petroleum products within the U.K. and Mr Shagrah showed how the pattern of distribution had changed throughout the years. The problem, he emphasized, was one of integrating the economics of distribution with the consumers' demand for a "push button service". The phenomenal growth of the market, now standing at 35 million tons per year and likely to reach 47 million tons by 1965, made the pattern of distribution developed up to 1950 completely uneconomic, and some 440 small depots had now been reduced to about 90 large ones strategically spaced throughout the country. These larger depots enabled bigger "drops" to be made, thereby considerably reducing handling costs. Since the larger depots could often be in the form of bonded stores, a large saving in working capital was possible. The remaining problems of very small "drops", for burning oil for example, had largely been solved by the appointment of a number of "authorized dealers" each covering a particular area.

Mr Shagrah ended his talk by discussing the use of oil pipelines in the U.K. and paid particular attention to the line from the Isle of Grain to London Airport and the lines from Stanlow to Partington. One of the latter, a "black oil" line 23 miles long was the longest unheated line of its type in the world. A number of pertinent questions on the paper were answered and the meeting closed with a vote of thanks proposed by the branch chairman, Mr Provest.

Yorkshire Branch

The Yorkshire Branch held its first meeting of the present session on 12 October at the Great Northern Hotel, Leeds. G. J. C. Vineall, chairman of the Branch presided and introduced R. P. Bell, technical director, Berry, Wiggins and Co. Ltd, who gave a talk entitled "Trackways to Motorways" which he illustrated with films and slides.

Describing the Roman trackway system as it was some 2000 years ago Mr Bell used comparative maps to show that had this system been maintained over the centuries, it would have provided an equivalent network of motorways to that now being built. He pointed out that not only were the "tracks" approximately as wide, ditch to ditch, as the modern motorways but the method of construction was very similar although Roman roads were paved with stone and there have been many changes in types of materials used since then.

The various methods of building modern motorways were discussed and it was explained how experience gained with the Preston motorway resulted in a more robust type of construction for subsequent projects. There was a tendency towards the use of stronger and more waterproof materials, which are more expensive due to higher mixing and laying temperatures. The advantages of asphalt over concrete, and the methods of maintaining the various road surfaces, were outlined.

Modern high speed roads needed considerable non-skid qualities and research into this was being carried out by the Road Research Laboratory. For example, specially adapted cars with an extra wheel, either trailing or built in, were used to measure the coefficient of friction of various road surfaces in a wet condition.

Laboratory research to ascertain the degree of polish which can be obtained on various road surfaces after contact with motor vehicle tyres is also being carried out. Films were used to show the various tests in progress. Coefficient of friction figures vary from a poor figure of 0·2 to a good figure of 0·8. Most research on road materials had been carried out at speeds of about 30 mph, but with the advent of high speed roads it might well be that future developments in anti-skid research will be directed towards improving tyres, and the more general use of butyl rubber tyres is likely.

A lively discussion followed Mr Bell's address and many questions were asked.

Scottish Branch

The Scottish Branch of the Institute held its first meeting of the 1960–61 session in the North British Station Hotel, Edinburgh, on 6 October.

Dr W. B. Peutherer, chairman of the Branch, presided over the meeting which took the form of a film lecture entitled "The Petroleum Industry's Role in the World Car Market Development".

The author, Dr K. E. W. Ridler of British Petroleum Co., was unable to be present and A. E. Lonsdale of BP Technical Services Branch, and P. Newman, BP Research Branch, presented the paper on behalf of the author.

In the film it was said that the growth in the world car market had required not only great expansion in the motor industry's productive capacity, but also major changes in vehicle design to meet widely varying operating conditions and the ever-present demand for better performance at lower cost. These requirements had called for the parallel development of fuels, lubricants, and other automotive products, permitting the potential of new design features to be realized to the fullest extent in all world markets.

The petroleum industry's extensive research on the development of new test techniques and equipment, were outlined—a notable example being the vehicle dynamometer. But it was emphasized that road tests were always necessary—under widely-varying climatic and road conditions—to prove new products in service, match them against car manufacturers' and official specifications, and ensure that they stood up to the petroleum industry's own standards of quality. This close co-operation between the motor and petroleum industries must continue both for current problems and to keep pace with the trend of future design.

After the film show there was a lively discussion and the meeting terminated with a vote of thanks to Messrs Lonsdale and Newman.

★ ★ ★

Oil on Show to Students

ESSEX BRANCH STAGES SUCCESSFUL EXHIBITION

Over two thousand students, boys and girls, from twenty-four secondary schools, technical schools, and colleges in the area from Romford in the west to Southend in the east, and from Brentwood in the north to the River Thames in the south, visited the oil industry exhibition organized by the Essex Branch of the IP and held from 18 to 22 October in Thurrock Technical College. And some of them not only visited the exhibition during the day but took their parents along in the evening, so attracted were they by the exhibits.

The exhibition was made possible first by the efforts of the Essex Branch Committee and particularly of their honorary secretary, D. Rawlinson, who was mainly responsible for the organization and arrangements. Much credit is due to the Governors of Thurrock Technical College for providing space and facilities for the exhibition, and also to the education authorities in the area who showed much enthusiasm and made it possible for students to be conveyed to and fro.

Lastly, and by no means least, there were the exhibitors themselves. Not only did they put on a splendid show of apparatus and models but they also sent along technical staff to explain their exhibits and to answer those awkward questions from students which so often give the technical man a reason for a bit of quick thinking. The writer was present during one session, when some 400 boys and girls passed through the exhibition, and can vouch for a genuine show of interest in the oil industry and a lively desire to learn more about it.

The exhibitors were:

Audley Engineering Company Ltd,
Bonallack and Sons,
Charrington, Gardner, & Lockett Ltd,
Lake and Elliott Ltd,
London and Thames Haven Oil Wharves Ltd,
Mobil Oil Co. Ltd,
Regent Oil Co. Ltd,
Shell Refining Co. Ltd,
William Warne & Co. Ltd.

Also included or depicted on certain exhibitors' stands were Brodie-Kent, Gilbarco, and Woodfield Rochester equipment.

The general arrangement was for the scholars to arrive at stated times in batches. First, a short film show, the length of which could be adjusted as a buffer to regulate flow through the exhibition itself. The films shown were designed to set the canvas for what was to follow, that is they gave some comparatively elementary information on oil and oil exploration.

The first exhibit consisted of two pictorial displays illustrating oil exploration and production. Following this were the main exhibits which provided an excellent coverage of the activities of the oil industry and illustrated some of the products obtained from crude petroleum. Thus, transport of crude oil was illustrated by models of tankers and of some of the equipment used in loading and discharging their cargoes. Loading hoses were also to be seen as well as automatic meters for the measurement of deliveries.

On the refining side, several interesting models were on view and evoked much interest particularly as some were dioramic landscape refinery models and plants to be seen in local refineries. Valves and pipe fittings were also displayed.

Exhibits of products were devoted more to the possibly lesser known formulations, such as paraffin waxes, liquid petroleum gases, bitumen, and so on. There were, however, exhibits covering the use of kerosine and distillate fuels for home heating and of marine uses of fuels and lubricants.

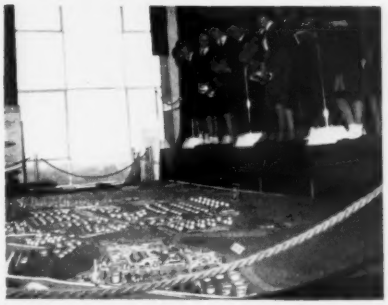
The distribution of petroleum products by road and rail was illustrated by means of a landscape model, complete with a working model railway.

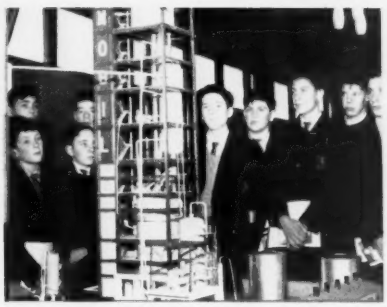
Photographs, in colour and in monochrome, were used effectively on most stands and one interesting display showed the development of road transport of oil from 1914 to the present day.

An idea of some of the operations of product research was given by photographs and equipment for the testing of fuel and heating oils, sulphur determination by x-ray absorption using a radioactive isotope source, and engine analysing, whilst process research was represented by a refractometer, a liquid-solid chromatograph, and a viscometer. The purpose and operation of these were explained by research staff.

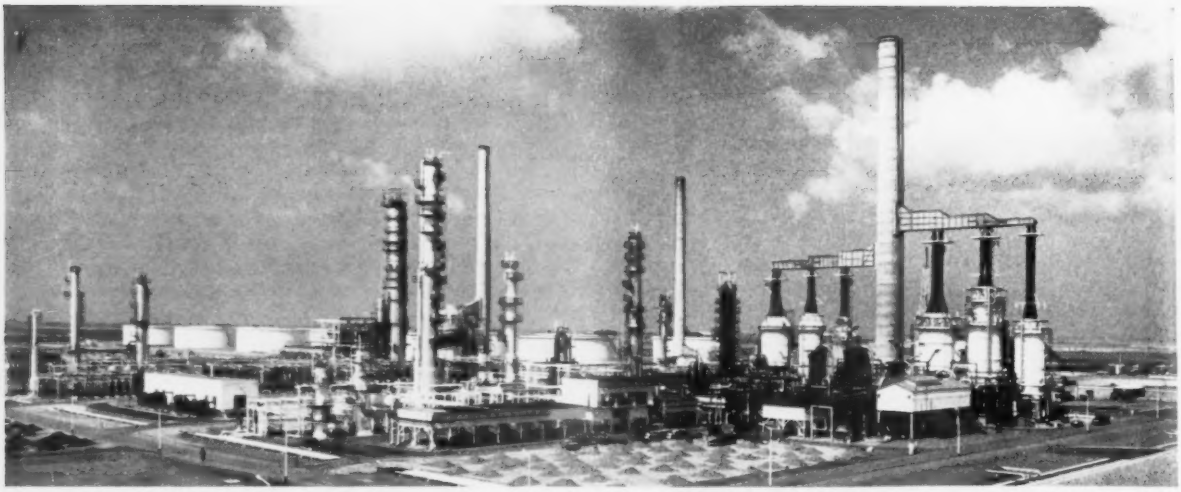
The Branch is to be congratulated on the well-deserved success of their efforts.

THE ESSEX BRANCH EXHIBITION





At the opening of the exhibition, many local dignitaries were present as seen in the central column of pictures taken by Mobil Oil Company's photographer. Subsequently, many students found much to interest them and the editor's camera caught a few of them in the pictures in the two outside columns



A general view of the Esso Rotterdam refinery. Left to right are the light ends unit and feed splitter, the crude distillation unit, the Powerformer, and the hydrofiner

ESSO NEDERLAND REFINERY

New Rotterdam Installation

Since 1891 Esso Nederland NV, an affiliate of Standard Oil Company (New Jersey), has been marketing petroleum products in Holland. During the last years its supplies were mainly obtained from the Antwerp refinery of Esso Belgium SA and from the Lago Oil and Transport Company at Aruba in the Netherlands Antilles.

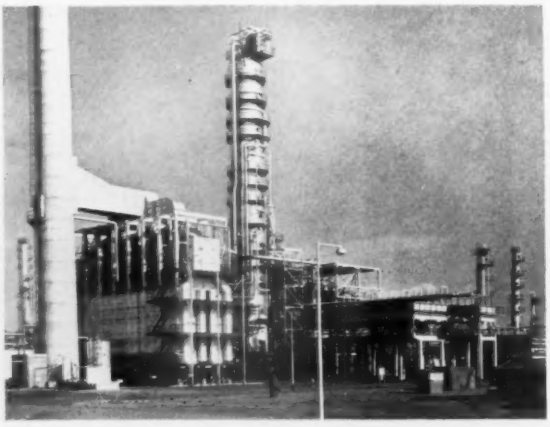
In recent years the increasing demand for petroleum products, not only in Holland itself but also in neighbouring countries, pointed the desirability of additional refinery capacity. It appeared that Rotterdam with its direct access to the North Sea and its excellent facilities for inland water transport, offered a convenient location.

The site selected was an area of about 475 acres, adjoining the 3rd Petroleum Harbour at Botlek, near Rotterdam, about 12 miles from the North Sea.

During the early months of 1957, Esso Research and Engineering Company was engaged on the development of process designs for a refinery with an annual throughput capacity of 5 million tons of crude oil. Badger NV was the main contractor; in co-operation with Esso Research and Engineering, Esso Nederland, and the architects, they handled engineering, procurement services, and construction. In the autumn of 1957 they planned the project. This planning involved detailed surveys as to the availability of all equipment needed for a modern refinery. Two important aspects which required careful investigation were the recruitment of more than 2500 workmen who were to be employed on the project, and the assurance that the suppliers of the wide variety of equipment would be able to deliver their goods when needed.

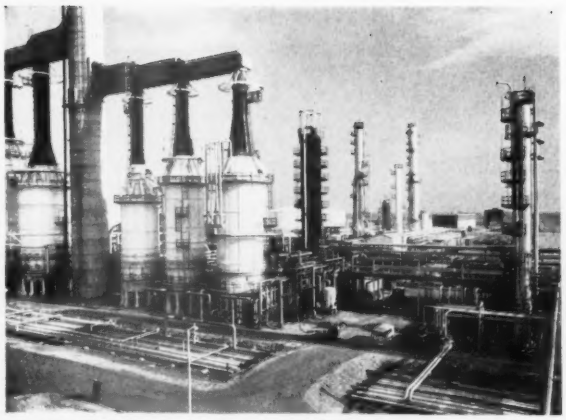
Although Esso's Rotterdam refinery is, what is normally termed a "grass-root" refinery, it would be more correct to describe it as a "sandy-bottom" refinery. The level of the refinery site was much lower than that of the river, and the first essential was to raise it in order to prevent the risk of flooding. To achieve this it was necessary to fill the area with some 17 million cubic yards of sand, a task performed by the Rotterdam authorities. The sand was pumped from the river bed and in some places a fill of approximately 13 feet was required. This work was completed by August 1958.

The 100,000 *bd distillation unit*



The work of preparing foundations for the refinery units, storage tanks, and so on started in the spring of 1958. It is estimated that about 40,000 cubic yards of reinforced concrete were used

in raft foundations for heavy equipment, and that over 2000 reinforced concrete piles were cast on the site and driven into the hard layer 80 feet below surface level.



Powerformer and hydrofiner

The Refinery

The design of the refinery itself follows conventional modern practice. The refinery has an annual throughput of roughly 5 million tons of crude and its main products are refinery gas, propane and butane gases, motor spirit, tractor vaporizing oil, kerosine-type jet fuel, diesel fuel and gas oil, domestic heating oil, and light and heavy fuel oils. About 20 to 25 per cent of the crude oil input will be supplied from the oilfields of Holland by the NV Nederlandse Aardolie Maatschappij, in which Standard Oil Company (New Jersey) has a 50 per cent interest. The remainder will be imported, initially, from the Middle East and, later, probably from Libya, where Standard Oil discovered a major oilfield in 1959.

Main unit of the refinery is the 100,000 barrels a day pipe-still. Overhead and sidestreams are split in different fractions which are subsequently treated for sulphur removal in various units, such as MEA (mono-ethanol-amine), Girbotol (diethanol-amine), copper chloride, caustic washing, and hydrofining.

The production of high octane gasoline is achieved by means of a Powerformer unit. Characteristic of the Powerformer and hydrofiner units are the six cylindrical furnaces, which are all connected via horizontal ducting to one common stack. The usual blending units and water treating facilities are provided. Cooling throughout is by air, circulated by variable-pitch propellers.

The plant includes the largest box furnace and the largest inert gas generator in Europe, and one of the biggest heavy duty cylindrical furnaces on the continent.

Product loading control room

Automatic Control

Processing, oil movement, and storage operations are automatically controlled from two control houses. Thus, the operation of the refinery from the entry of crude oil to the loading of finished products is centrally controlled by electronic means.

Storage

For storage of crude oil there are thirteen tanks with a total capacity of over 300,000 metric tons. For the storage of intermediate and finished products over seventy tanks are available in a large variety of sizes, with a total capacity of approximately 500,000 metric tons.

Jetties

Two jetties are available, one for incoming crude oil cargoes and for bunkering tankers, and the other for the handling of outgoing products. Both are of Dutch design. Tankers of up to 50,000 dw tons can be accommodated at the main jetty. A barge terminal is also available for the loading of outgoing products.

Pier No. 1 comprises five loading arms of the rigid type, four being used for unloading crude, and one for bunkering purposes. A Woodfield 3-ton boom luff winch is air-operated by a piston engine and remote controlled by solenoid-operated air valves. The solenoid operated air control system for the "Ingersoll Rand" boom hoists forms part of the "Woodfield" supply and includes valves arranged to provide two speeds to the hoists. Push-button control is from a cabin mounted on the end of the structure by means of which the flanges on the loading arms are brought close to the corresponding flanges on the tanker outlets. For final positioning an ingenious portable remote control has been devised by Badger and Woodfield Rochester Ltd so that the operator can work alongside the manifold on the vessel. It consists of flame-proof push buttons contained in a portable case with flexible electric cable back to the control cabin on the jetty. Problems of weight and flame-proofing were overcome by the

Part of the main refining control room

use of plastic material for the cabinet and push buttons to German explosion-proof standards. These are of a size which avoids the cabinet becoming large and unwieldy.

Construction Features

In the course of construction about 170 miles of pipe were used, procured from the U.K., the U.S.A., and several continental countries. As far as possible all fabrication and welding was carried out on the site, and it is estimated that over 2600 tons of pipe were handled in the special pipe-welding shop.

Among the materials used were:

30,000 tons of steel;

10,000 tons of cement;

110 miles of buried cable;

185 miles of instrument cable;

10,000 cu ft of timber.

Throughout the construction stage extensive use was made of scale models of units, showing the lay-out of piping and auxiliaries, and these proved of great assistance. These models are still in use for the training of operators and for the use of maintenance staff.

It is of interest to record that even a major change during construction, in the specifications for a major process unit, caused no serious delay in the work.

Thanks to good organization and proper co-ordination between all parties involved, Badger was able to complete the project in less than two years, with the help of the reliable services of a score of Dutch and foreign sub-contractors.

The refinery came on stream in February and was formally opened by Prince Bernhard on 12 May 1960.

The principal sub-contractors for construction were:

NV Amsterdamsche Ballast Mij—Civil engineering.
Birwelco Ltd—Cylindrical heaters.
NV Inter. Techn. Handelmij. v/h Fa. F. J. Cleton—Insulation.
Geerdink Aannemersbedrijf NV—Piers.
Hollandsche Beton Mij.—Piling.
Joh. Mourik & Co. Aannemers Mij NV—Grading.
Bouwbedrijf der Kon. Nederlandsche Mij voor Havenwerken NV—Barge terminal.
Van Rietschoten & Houwens Electrotechnische Mij NV—Electrical.
Werkspoor NV—Mechanical.
Woodfield Rochester Ltd—Hose handling equipment.
Chicago Bridge & Iron Company—Tanks.
Pletterij Enthoven—Tanks.
Geerdink Aannermersbedrijf NV—Buildings.
Dura's Aannemings Maatschappij—Buildings.
Hillen & Roosen—Buildings.

One of the jetties and pipe track for the refinery

★ ★ ★

Personal Notes

In addition to his duties as group development chemist **N. E. F. Hitchcock,** B.Sc., F.Inst.Pet., has been appointed laboratory manager of the Castrol Group's main research establishment at Hayes, Middlesex, in succession to the late P. W. L. Gossling.

N. E. F. Hitchcock

Norman Hitchcock who is 49 joined Castrol Ltd (then C. C. Wakefield & Co. Ltd) 32 years ago as a laboratory assistant. He was a founder member of the London Branch of the Institute and served as its chairman in 1949.

We regret to record the death on 13 October of **The Earl of Verulam,** chairman of Sternol since 1950. He was the holder of a number of directorships in banking, industry and commerce.

A. R. B. Hore has relinquished the secretaryship of the British Oil Burner Manufacturers Association to undertake additional duties in the London Chamber of Commerce of which he is a Deputy Assistant Secretary. He will be succeeded by Stanley Brown a senior member of the Chamber's staff, who has a wide experience of trade association work.

M. C. Coleman, B.Sc.(Eng)., A.M.I.Chem.E., M.S.M.A., A.F.Inst.Pet., has been appointed sales manager of the Clark Bros Co., Division of Dresser (Great Britain) Ltd.

A. E. Richards has been appointed managing director of Universal Matthey Products Ltd, the joint subsidiary company of Universal Oil Products Co. and Johnson, Matthey & Co. Ltd.

F. T. Levi, Civ.Ing.(Stockholm), A.M.I.Chem. E., A.F.Inst. Pet., has been appointed technical director of Victor Wolf Ltd. He joined the technical staff of the company 18 months ago after having been senior process engineer with Petrocarbon Developments Ltd.

Regent Oil Co. Staff Changes

Recent changes in the staff of Regent Oil Company's Technical Department include the appointment of **T. F. McGuinness,** M.I.Mar.Eng., A.M.Inst.Pet., as manager, **P. H. B. Trasler,** M.A., F.Inst.Pet., as co-ordinator of laboratory services, and **G. W. Scott** as chief technical services engineer. From 1 October **R. E. Buell,** manager, and **B. M. Pool,** B.Sc., F.Inst.Pet., technical service manager, relinquished their respective positions pending transfer to other assignments within the Caltex Group. **A. E. Gerty** also relinquished his post as technical operations manager in view of his impending retirement at the end of the year.

Britain's Largest Tanker Launched

A 65,000-TONNER FOR SHELL

It is always an awe-inspiring sight to watch a new ship glide down the slipway on her first entry into the water. And the launch of *SS Serenia*, the new 65,000-dw ton tanker for Shell Tankers Ltd, from the Walker Naval Yard of Vickers-Armstrong (Shipbuilders) Ltd on 18 October was no exception. No sooner had the Hon Mrs Richard Wood, wife of the Minister of Power, named the vessel and pulled the launching lever, than the 15,000 tons of steel moved majestically down the ways. As she finally entered the water and swung round into the narrow fairway of the Tyne, a great cheer went up for a perfect launch and many must have sighed with relief that an operation fraught with anxiety was safely over. For this was the biggest of two things—the biggest merchant ship yet built on the Tyne and biggest tanker yet built in Britain.

Speaking at the luncheon which followed the launching, H. Wilkinson, C.M.G., chairman of Shell Tankers Ltd, said that the Walker Yard was famous for such naval ships as *Hermes*, *King George V*, and many others. That day they had seen a peaceable vessel launched, the largest tanker yet launched in Britain, and the biggest merchant ship launched in Britain since the "Queens". Two sister ships to *Serenia* were being built, one on the Tyne and one on the Mersey.

Serenia, he said, was a product of British industry and her launch was conducted against a background of heavy world surplus of tanker tonnage which presented a grave problem. But *Serenia* was so efficient that she would be able to trade profitably for many years.

He went on to say that the estimated expansion in trade and the obsolescence of existing ships would be able to account for only part of this surplus, and that in his opinion it was up to tanker owners to accelerate obsolescence by scrapping some of their tankers. "Only this morning," he said, "we made final arrangements to scrap no less than 20 of our vessels—good ships, none of them more than 16 years old and two of them much younger. Ordinarily we would not have done this, but the action has been taken because of the large surplus of tanker tonnage in the world".

SS Serenia

Built to Lloyd's highest class for the carriage of petroleum in bulk, the vessel also complies with the latest requirements of the Ministry of Transport and Factory Acts. Her principal dimensions are:—

Length overall	...	...	817 ft 9 in
Length b.p.	...	...	775 ft 0 in
Breadth moulded	...	...	112 ft 6 in
Depth moulded	...	...	57 ft 9 in
Load draught	...	...	42 ft 6 in
Deadweight (approx.)	...	...	65,000 tons.

The vessel is of the single deck type, with poop, bridge, and forecastle, having a raked stem and cruiser stern.

The framing is longitudinal throughout the length of the cargo tanks and transverse forward and aft of these.

The hull is subdivided as follows:—

Fore peak and chain locker;
Oil fuel deep tanks;
Cargo oil and clean ballast compartments;
Pumproom;
Wing bunkers and settling tanks;
Machinery space with double bottom;
After peak.

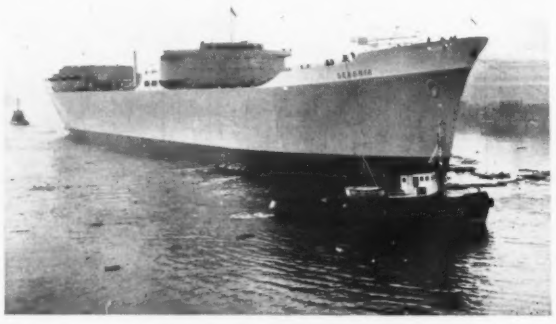
Two main longitudinal bulkheads separate the wings from the centre tanks, providing 42 tanks in all. Of these, 33 are available for the carriage of cargo oil and the remaining 9 for water ballast.

The pumping installation includes four vertical centrifugal turbine-driven cargo oil pumps with a capacity of 1900 tons of water per hour and three vertical duplex stripping pumps, each having a capacity of 200 tons per hour.

Two vertical single-stage centrifugal ballast pumps, with a capacity of 2000 tons per hour each, are fitted. These pumps are also turbine driven.

The accommodation is to Shell's high standard of comfort and convenience. Spacious cabins are provided for the deck officers in the bridge house and for the engineers on the after boat deck. The petty officers and crew are accommodated on the poop deck and upper deck aft, a separate cabin for each man having been provided in most cases. The galley, pantries, and messes have been arranged round the machinery casing on the poop deck, with the officers' dining saloon, smoke room, and recreation room grouped conveniently together on the port side. The crew's recreation room is arranged on the upper deck aft. A swimming pool is provided on the after boat deck. Air conditioning is arranged throughout all accommodation.

The main machinery consists of double reduction geared turbines capable of developing 22,000 shp, sufficient to give a service speed of 16½ knots. Steam will be provided by two Babcock and Wilcox selectable superheat type boilers. The machinery is being supplied and fitted by Vickers-Armstrongs (Engineers) Ltd, Barrow-in-Furness.



SS Serenia *lying in the river after the launch*

Retirement of Professor Garner

TRIBUTES FROM BIRMINGHAM UNIVERSITY STUDENTS AND STAFF

Some 200 students, graduates, and staff of the Chemical Engineering Department of the University of Birmingham, together with some personal friends, gathered at the Grand Hotel, Birmingham, on 15 October, on the occasion of a Farewell Dinner to Professor F. H. Garner, O.B.E., who retired from the Chair of Chemical Engineering at the end of September.

Speaking on behalf of the present students, **A. R. W. Large** first recalled in humorous vein some events which he associated with Professor Garner. He concluded by saying that the professor had given them much to admire and had established a society which was the greatest in the University.

On behalf of the graduates, **Dr W. A. Pearce** said that the two outstanding characteristics of Professor Garner were, first, his popularity and, secondly, his profound knowledge of facts coupled with his ability to take over jobs where others finished. He instanced a case when as a student he made a special study of wood-finishing to determine just how extensive Professor Garner's knowledge was, but having turned the conversation to this topic, it was not long before Professor Garner was showing a much wider knowledge of the subject and completed the afternoon by giving a lecture on how antique furniture was faked.

The Professor played a major part in building the existing Department from its 21 students in 1942 to over 350 at the present time. This was an amazing feat for in this he had to break down a lot of the traditions of the old Department and then start afresh building a new Department. The result was a Chemical Engineering Department second to none.

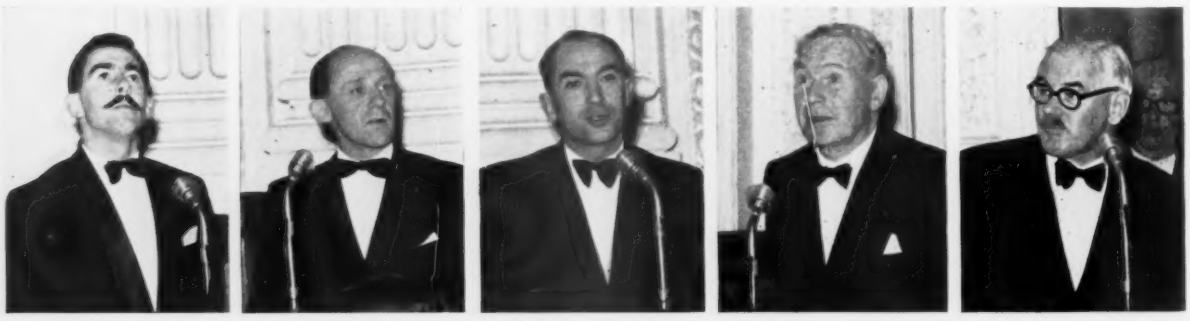
In his experience, said Dr Pearce, industry got their money's worth from students who had been trained in the Chemical Engineering Department at Birmingham under Professor Garner and his staff.

Dr M. F. Mohtadi, on behalf of the staff of the Department, referred to the spirit of comradeship which had existed for a number of years throughout the Department. It gave them all the feeling of "belonging". A special quality of Professor Garner was his humanity, his kind friendliness, and his interest in others. He was sure this was not bettered in any other department or in any other university.

Concluding, he said that it gave him great personal pleasure to express his gratitude to Professor Garner for his leadership and for his appreciation of the work which was being done in the Department.

Professor M. B. Donald spoke on behalf of the many friends of Professor Garner, both inside and outside the University, and especially for those from outside who were privileged to be there as guests that evening. The latter were an indication of the widely diverse interests of Professor Garner and included:

Tributes to Professor Garner were expressed by (left to right): *A. R. W. Large, Dr . . W. Pearce, Dr M. F. Mohtadi, Professor M. B. Donald, and the toast of his health was proposed by Professor Stacey G. Ward*



K. Birch presenting a gift to Professor Garner

Sir Herbert Manzoni, president of the Institution of Civil Engineers who was a co-member with Professor Garner on the Board of Loughborough College.
Sir Harry Garner, formerly Chief Scientist, Ministry of Supply.
Vice-Admiral Sir Frank Mason, who was concerned with fuel and lubricants for the Royal Navy.
Dr A. J. V. Underwood, the well known pioneer in chemical engineering.
A. J. Toppin, Ulster and Norroy King of Arms.
Dr C. M. Cawley, chief scientist, Ministry of Power.
Dr J. B. Brennan, M.B.E., secretary, Institution of Chemical Engineers.
Dr E. B. Evans and George Sell, honorary editor and editor respectively of the Institute of Petroleum, of which Professor Garner had been President and for many years its honorary editor.
G. le B. Diamond and Dr F. J. Dent, of the West Midlands Gas Board.

He had been an external examiner over a considerable period of the last 18 years and had thus been able to see some of the results of Professor Garner's work, said Professor Donald. The thought and experience applied to each new development were a sound foundation for the future and Birmingham University were to be congratulated on having had for 18 years so wise a man as head of the Department.

To **Professor Stacey G. Ward,** Dean of The Faculty of Science, fell the honour of proposing a toast to Professor Garner. He himself had been a junior lecturer in the Department when Professor Garner had been appointed to the Chair in 1942. During these 18 years Professor Garner had been a great force in the life of the University. He had taken a keen interest in the whole range of student activities, both inside and outside the University. He was a modest man and had wide interests in the history of science, in books and book production, in delftware, and in many other directions. Fortunately he would not be disappearing completely from the University but would be remaining in a special capacity.

The toast, wishing Professor Garner happiness in his retirement from the Chair of Chemical Engineering which he had occupied in so distinguished a manner for so long was given with acclamation.

Professor F. H. Garner, thanking them for their reception of the toast, said that his first contact with the Department was nearly 40 years ago in connexion with a lecture which he was giving on the University of Birmingham. Later he had been an external examiner during Professor Nash's term of office.

The Department owed much to such men as Professors Stacey Ward, Morton, and Ellis for the work which they had done particularly during the formative years.

Briefly outlining his own career, he said that after one year at the RAE, Farnborough, working on petroleum problems, he went to the Mellon Institute. He then accepted an offer of £400 a year to take charge of technical work for the newly-formed Agwi Petroleum Company at Fawley. After seven years he proceeded to London and for fourteen years was working in various capacities for the Esso organization. In

Professor Garner accepting from Dr C. W. Nutt the gift of a radiogram and a television receiver

1942 he accepted the chair at Birmingham and had never regretted the change.

It had been his good fortune, said the Professor, to have been in contact with students for so long. He considered it essential for the head of a department to realize just how much he should know of what was going on in the department. As an example, he quoted verbatim an illuminating report on the visit of a certain brigadier to the Department. It had been conveniently placed for him to find, but he had not thought it necessary to make enquiries about its authorship.

Thanking them all for the remarks which had been made and for their reception of them, Professor Garner sat down to prolonged applause.

Presentations

K. Birch, on behalf of the *Birmingham University Chemical Engineer*, asked Professor Garner to accept a bound copy of that journal which contained an illustrated history of the

At the Iranian Students' Dinner (left to right): *Professor Garner replying to the toast proposed by H. Sheikhuleslami; Sir Robert Aitken, Vice-Chancellor of the University; and E. Nabavi also spoke of Professor Garner's attainments*

Among those at the Iranian Students' dinner were E. Nabavi, Dr Bahari, Professor F. H. Garner, Dr Crooks, H. Sheikhuleslami, Professor S. R. M. Ellis, H. Gilmour

Department. He also presented a pencil and crayon portrait of Professor Garner which had been sent by V. R. Gowariker, an Indian student.

Dr C. W. Nutt, on behalf of all present, asked Professor Garner to accept three tokens of their feelings which had been expressed so adequately by others that evening. The first was a silver bowl which would incorporate certain alchemic symbols, the second was a radiogram, and the third a television receiver.

Also on exhibition was a portrait in oils of the Professor by Peter Gross, a Birmingham painter, which had been presented by the Academic staff.

Professor Garner thanked all for their gifts in a short concluding speech.

Services to Iranian Students

On 24 October Professor Garner was guest of honour at a dinner given by the Iranian Students' Society of the University, the chair being taken by H. Sheikhuleslami, chairman of the Society. The guests included Sir Robert Aitken, Vice-Chancellor of the University, E. Nabavi, London representative of National Iranian Oil Company, and members of the academic staff.

Proposing the toast to Professor Garner, the Chairman said he felt it an honour to be paying a tribute to Professor Garner, not only on behalf of those students present but also on behalf of the generations of students who had been there before. He had won a place in their hearts and had performed a great service to their country, and had contributed to the progress of modern Iran more than most other men. He had provided vital technical education to a people whose principal wealth, oil, needed the most advanced modern techniques for its development.

It was not only the value of the education which he had provided that made them respect Professor Garner so much, said Mr Sheikhuleslami, but aslo the real interest he had taken in all aspects of their civilization. He had sought from Iran the beautiful things the country had to offer and in which they were at least equal to and sometimes better than the West. By this he had shown that he really appreciated their country and wished to understand it. Not only had he always been a good teacher for Iranians, he had always been a good friend.

The toast to Professor Garner was accorded long applause.

Sir Robert Aitken, Vice-Chancellor of the University, described how Professor Garner had graduated in the University of Birmingham, spent many years in the oil industry, and then in 1942 had returned to the University to be head of the school of oil technology. He wondered why Professor Garner had made that important move in 1942. His great interest in research was part of the reason, and another part was his concern for people, especially young people, and his fondness for teaching. But in addition, Sir Robert imagined, he must have dreamt of the large and exciting school of Chemical Engineering which could be built on the foundations of the school of oil technology. He not only dreamt of it; with much hard work, he built it, and in the building of it a worthy part was taken by the ever loyal students from Iran.

Professor Garner's great success was reached by his concentration of effort upon a few aims. They were chemical engineering, ceramics, and books. Eminence is seldom achieved by those who dissipate their energies.

In conclusion, Sir Robert called upon those present to again drink to the health of Professor Garner.

E. Nabavi, National Iranian Oil Company, referred particularly to Professor Garner's assistance to the Iranian students at a time when they were in certain difficulties due to international trouble. Then they had needed help to continue their studies and Professor Garner had not hesitated to provide that help. He had shown affection not only for the Iranian students but for the Iranian nation as a whole. By so doing he had done much to restore faith in British integrity.

It gave him much pleasure said Mr Nabavi, on behalf not only of those Iranian students present but also on behalf of many who could not be present that evening, to ask Professor Garner to accept a portrait of himself by an Iranian artist.

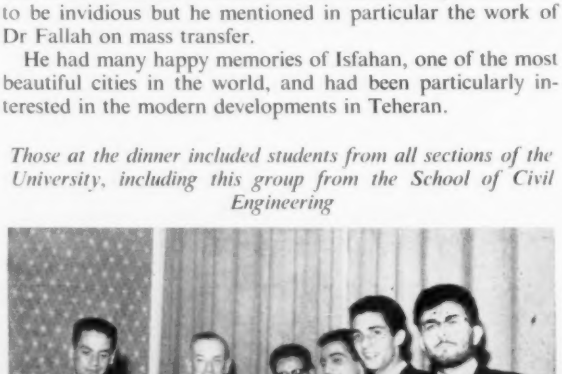
The portrait, in a frame of exquisite Persian inlay work, was presented amid prolonged applause.

Professor F. H. Garner acknowledging the toasts and thanking Mr Nabavi for the gift of the portrait, said he came back to Birmingham University because of the blandishments of the deans—then past, present, and future. He had always been interested in students and their studies and this had had a considerable effect on his acceptance of the post.

He was happy that this was a gathering of the Iranian Students' Society for the University had been fortunate in the calibre of the students from Iran. It was difficult, he said, not to be invidious but he mentioned in particular the work of Dr Fallah on mass transfer.

He had many happy memories of Isfahan, one of the most beautiful cities in the world, and had been particularly interested in the modern developments in Teheran.

Those at the dinner included students from all sections of the University, including this group from the School of Civil Engineering



Notes of the Month

BP Chairman Reviews Some International Oil Topics

The Hon. M. R. Bridgeman, chairman of The British Petroleum Company, reviewed some aspects of the world petroleum industry in a speech at the opening of the new BP Ruhr refinery at Dinslaken, Germany, on 20 October. Mr Bridgeman made the following comments.

"The building of this refinery represents a further major addition to BP's investment in Western Germany. It will provide the means whereby we can continue our part in supplying the country's oil requirements which have increased very rapidly over the last 12 years, and are evidence of the vitality of the economy. During these years, BP has spent over £72 million on the provision of refining, petrochemical, and distribution facilities in Western Germany."

The refinery was said to be an example of the continued call for capital expenditure which was a feature of the oil industry and extended over the whole range of its operations. For the BP Group, capital expenditure had amounted to £391 million in the last three years alone. A large part of this capital must necessarily be provided in the form of retained earnings, and BP had, over the last 10 years, reinvested over 70 per cent earnings in that way. This was one reason why the maintenance of reasonable price levels was so important.

"It is often suggested that seven or eight large companies entirely dominate the international oil business and while achieving a complete unanimity of policy among themselves, form a club to which no further members can be elected. This is very far from the truth. In the first place, the larger companies compete very actively with one another, as everyone can see for themselves. In the second place, none of them were born large—for the same reason that children, perhaps fortunately, are not born full-grown."

On the subject of company profits, it was pointed out by the chairman that the dividend paid out to BP stockholders last year represented only 1/3 penny per gallon of Group sales.

"Some companies entering for the first time into exploration activities in the Middle East have claimed that agreements they have made with the Governments of the producing countries are more advantageous to the latter. I believe that it would be more rational to defer such claims until there has been actual experience of the results of these agreements, which cannot be known until oil has been discovered and production developed to a commercial stage. The appearance that these agreements give the Government concerned, through participation, a higher proportion of the profits, may well prove illusory where the Government has to provide its share of the capital required for development.

"The income of the producing countries in the Middle East from the 50/50 agreements is presently at the rate of approximately £490 million per annum, and whether they will derive as great a benefit from other forms of partnership, still remains to be seen.

"Suggestions have also been made that the trade in oil should be transferred from the present commercial basis to become a matter to be dealt with directly between the Governments of the producing and consuming countries. Quite apart from the greater flexibility of the present system from the point of view of source as well as of quantity and quality, I believe that there are greater prospects of peace in the world if international commerce can continue to be conducted at the commercial level, just as international political affairs are conducted at the political level."

Governments' Role in the Oil Market

An article by the industrial economist, J. E. Hartshorn, in the October issue of *The Banker*, entitled "Governments and World Oil Prices" comments on the varied reactions by national governments on the recent crude oil price cuts in the Middle East, and the influence of governments on the present economic ills of the world oil market.

The resultant private conference in Baghdad of the representatives of the six members of "The Organization of Petroleum Exporting Countries"—Venezuela, Kuwait, Saudi Arabia, Iran, Iraq, and Qatar—is cited, with its pressing for the cancellation of the cuts and its determination to improve the producing-countries' share of oil revenues and to study methods of regulating oil production. In Europe, different circumstances resulted in Belgian tax protection of its coal industry (following Germany's example) and, in contrast, the Italian government's support of ENI's position by the reduction of duty on gasoline.

The writer points out that the world-wide government relations of the major international oil companies—"among the world's only genuinely international economic phenomena" have obviously been made more difficult in this present period of world oil surplus. Whilst examining the role of governmental influence as a partial cause of the surplus itself he emphasizes that the greatest single influence which encouraged huge investment in oil exploration and tanker construction was the logical assumption that U.S. demand would continue its rapid rate of increase and maintain the import flow from the Middle East and Venezuela. With the mandatory control of imports into the country, the U.S.A., as Mr Hartshorn remarks, "really precipitated the situation of surplus in the world market from which it was deliberately insulating itself".

The not inconsiderable influence upon this situation of the entry of relative newcomers into the international market in the last few years is surveyed, and it is commented that the American Government bears much more responsibility for the current softening of oil prices than the Russian Government. The writer concludes by mentioning the growing influence upon the market of nationalized and semi-nationalized companies from consumer countries, and the Arab Oil Congress call for "international proration" of oil exports.

Natural Gas Utilization in Qatar

A natural gas pipeline is to be built from the Dukhan field in the west of the Qatar peninsula to Doha, the capital, in the eastern section, to supply power stations, water distillation plants, and other installations. The pipeline will comprise some 50 miles of 10-in pipe and about 10 miles of 6-in and a dehydration plant will be constructed at Dukhan.

Consulting engineers and designers for the pipeline system, which is scheduled for completion in March 1961, are Rencol, Pipeline and Engineering Consultants.

Natural Gas Supply for Whitby

On the 23 September the inauguration took place of a scheme whereby natural gas from the district will be supplied for use as town's gas at Whitby on the Yorkshire coast, the first town in Britain to have all its gas from such a source. At the ceremony the North Eastern Gas Board entertained the Minister of Power and other prominent individuals.

It was said by the Minister that he hoped that later, gas would be supplied to other towns in the district such as Pickering, Malton, Kirkbymoorside, and Hemsley. For this reason the reforming plant which had been erected at Whitby was far larger than was required for the town itself.

The project had cost £124,000 and according to Harry Johnston, chief engineer of the NE Gas Board, would result in a saving of 6000 tons of coal a year. There was sufficient gas to supply the town for a minimum of 25–30 years.

Since the end of the 1939–45 war, ICI has engaged in exploration for natural gas in the U.K. jointly with BP Exploration Co. Ltd with a view to its possible use by them. ICI considered, however, that the reserves of gas were insufficient for their requirements and in September 1959 the North Eastern Gas Board, in agreement with British Petroleum and ICI arranged to purchase as much gas as may be made available, and initially supply Whitby, a town of approximately 12,000 inhabitants. In the course of operation 11 wells have so far been drilled but only two, Nos 2 and 10 have been proved to be gas producers. The two wells are independent of each other and do not draw from a common reserve.

The No 2 well has a closed pressure of 1700 psi and draws gas from an upper limestone layer 4196 ft below surface level. It is capable of producing gas at the rate of 2·5 m cu ft/day. The No 10 well has a closed pressure of 1900 psi, and draws gas from a lower limestone stratum 4807 ft below ground level. It is capable of providing a flow rate of up to 2 m cu ft/day. The producible gas reserves from the two wells have been estimated to be 1500 m cu ft, although it is thought that this may possibly be exceeded by a further 2500 m cu ft, and practical steps are being taken over the next year or so to determine accurately the extent of the full reserves.

The two wells were mud-sealed and capped until April this year, when they were re-opened and fitted with new casing heads and "christmas trees". Analyses of the gas from each of the two wells are as follows:—

	Aislaby No 2 Well	*Grosmont No 10 Well*
CH_4	93·17	93·93
C_2H_6	0·79	1·87
C_3H_8	0·43	1·56
C_4H_{10}	0·10	0·38
CO_2	0·28	0·23
N_2	5·23	2·03
H_2S	Nil	30 grains/100 cu ft
Organic Sulphur	Nil	Nil

The average calorific value is approximately 1000 Btu/cu ft and specific gravity 0·59.

After de-watering and pressure reduction at the well-head, gas flows by a 3 in steel main directly to the Whitby Gas Works six miles away. The line has an initial pressure of 200 psi, and a final pressure of 90 psi. After pressure and flow control the gas passes through oxide purifiers for the removal of any H_2S into a methane holder, from which gas is taken at low pressure, and directly to a PG Hercules plant for reforming methane to hydrogen and carbon monoxide, followed by cold enrichment with methane to a gas of 500 Btu/cu ft, specific gravity 0·54, Group 5 gas. This gas wholly replaces the town gas, now made from carbonizing coal in horizontal retorts with producer gas dilution. To cover any temporary interruptions of flow of natural gas from the wells, provision is made for reforming of butane to gas of the same approximate composition.

The pressure-reducing and flow-control equipment was designed and manufactured to the Board's requirements by the Bryan Donkin Co. Ltd, of Chesterfield.

As the whole plant was put into commission only a few weeks ago it is not possible as yet to give any information on operation or plant performance.

Drilling Activity in Iran

The state of drilling in areas outside the Consortium concessions in Iran was as follows on 15 October last.

NIOC

Alborz No 8 is being tested at a depth of 11,525 ft with the last casing placed at 10,697 ft.

Sarajeh No 3 is being tested at a depth of 12,180 ft (last casing at 11,723 ft) and Sarajeh No 4 at a depth of 10,700 ft with the last casing at 10,699 ft.

Drilling of Gorgan No 5 started on 14 September and is now at a depth of 3641 ft with the last casing at 1075 ft.

IPAC

Oil shows at A-1 Well in the offshore agreement area of the Persian Gulf are being tested. B-1 Well, also in the offshore agreement area, is drilling at 11,229 ft with the last casing at 4005 ft.

SIRIP

No 1 Well in the offshore agreement area of the Persian Gulf is being tested at a depth of 11,011 ft with the last casing at 9660 ft. At Sequta in the Zagros agreement area the well had been drilled to a depth of 9676 ft when it was decided to divert it. The diversion was made at a depth of 4265 ft, and successfully completed. Drilling is now going ahead.

Persian Pipeline Developments

Construction work on the 480 km 8-in Shahroud-Meshed pipeline begun on 1 November, being the second stage of the Tehran-Meshed products line, which forms the eastern branch of the Trans-Iranian pipeline network.

Construction of the 140-mile 10-in natural gas pipeline from Gach Saran to Shiraz has now been completed, and the line is being tested. This line, which has a capacity of 570,000 cu metres/day, was originally designed to supply the chemical fertilizer factory in the outskirts of Shiraz. However, it is planned that the natural gas will eventually be used to meet both the industrial and domestic fuel requirements of the growing city of Shiraz. Construction of the gas treatment plant at the Shiraz terminal is also under way.

Gulf to Build New Refinery in Scandinavia

Gulf Oil Corp has announced plans for the construction of a new 30,000 bd refinery in Denmark or Sweden, and is in the process of acquiring options on suitable land sites.

The refinery is not specifically designed for the exclusive use of any single type of crude but will produce a range of products to meet demand in North Europe where Gulf already has substantial marketing outlets.

Major Natural Gas Area in NW Canada

What appears to be a major gas discovery was made early in September by Imperial Oil and Pacific Petroleums on Canada Southern's 68,000-acre Permit 102 in north-east British Columbia, in which the company has a 21½ per cent interest. The discovery well encountered one of the thickest sections of Bluesky sand found to date in British Columbia, and indications are that its shallow depth will permit fast and inexpensive development of the field's reserves. The discovery site is only 30 miles north of an existing gas pipeline extension of the Westcoast Transmission system.

It is thought that this portion of western Canada from the Fort Nelson area in north-east British Columbia, northward into the Northwest Territories, is one of the most prolific natural gas provinces in the Western Hemisphere, both as to actuality and promise.

Petrochemical Project in South Wales

British Hydrocarbon Chemicals Ltd, is developing plans for a major extension of its manufacturing activities at a new location in South Wales.

For nearly ten years the company has been actively engaged in the petrochemical industry at Grangemouth, receiving its supplies of feedstocks mainly from the adjacent BP refinery.

BHC's proposed site, of several hundred acres, will be within a short distance of the BP Llandarcy refinery and the general pattern of operations can be expected to follow that at Grangemouth.

The introduction of this new and important industry into South Wales will, it is hoped, make a welcome contribution to the economy of the area. Such a project can only be initiated on a large scale and, while no capital authorizations have yet been approved, initial investment may well be about £10 million.

SONJ–CEPSA Appeal to Spanish Government

Standard Oil Company (New Jersey) has joined Compania Espanola de Petroleo SA in appealing to the Minister of Industry over the Spanish government's refusal to permit the two companies to form a $10-million petrochemical business consisting of three plants in northern Spain.

The joint application for necessary government permission was submitted to the Minister last May and denied on 2 September.

In appealing the decision, the Companies argued against the government's contention that their proposed facilities would duplicate those of competitive applicants recently approved in Madrid. With statistics, market studies and graphs, tracing the growth of petrochemical demand in Western Europe, they countered the minister's arguments that chemical plant expansion in Spain must await future demand. Presentations to various government ministers have pointed out that the Jersey–Cepsa project would attract other industries to Spain.

If approval of the Jersey Standard–Cepsa application is obtained the two firms will form a partnership to produce and market more than 24,000 tons of petrochemicals per year. Included would be raw materials for detergents, plastics, and rubber for Spanish industry. Ultimate investment in the overall petrochemical industry in northern Spain could reach $26 million.

BP and SOCAL Petrochemical Venture

The British Petroleum Company and California Chemical Company (Standard Oil Co. of California) announce a £7 million joint venture for the immediate construction of two aromatics manufacturing plants in Europe. The joint undertaking will be known as BP California, and British Petroleum will operate the units on its behalf. The units will be located adjacent to existing BP refineries at the Isle of Grain and Dinslaken, West Germany, and production is scheduled to begin in late 1961. In their initial phases the installations will produce 19,000 tons/year of orthoxylene, 16,000 tons of ethyl benzene, and 22,000 tons of paraxylene.

Contracts for building the Kent plant are being negotiated with Badger, Bechtel, and Wimpey. Contracts for the Dinslaken plant had not been signed at the time of writing.

Flux Grease-Testing Rig

To test radiation-resistant oils and greases for use in nuclear engineering projects under actual operating conditions, a test rig has been designed by Mobil Oil Co. at the Technical Services Laboratory at Coryton. This rig, SETRA (Submerged, Elevated Temperature, Irradiation Apparatus) is the first dynamic grease rig running under simulated conditions of U.K.-type cooled reactors of high gamma flux, and has been operating since June in the spent fuel element gamma facility at Harwell.

A survey of reactor operating conditions revealed that gamma radiation predominates in those reactor components requiring lubrication. Unlike pile irradiation, the use of a gamma facility permits test assemblies of reasonable size to be used and larger quantities can be irradiated; also lubricants can be handled immediately after irradiation.

The whole apparatus is submerged and located at the bottom of the fuel element irradiation pond at Harwell and spent fuel elements from the DIDO and PLUTO reactors are arranged around the bottom of the irradiation sample can to provide the desired gamma flux. The test assembly is at the bottom of the sample can where a high gamma flux of up to 3 megarads/hour can be obtained, whilst the electric motor is located as far from the bottom as possible in order to minimize radiation damage to the windings, etc.

Failure of a grease is denoted by a rise in temperature, but there is also an overload "cut-out" on the motor in the unlikely event of excessive grease stiffening before a temperature rise. To date products have been tested to radiation levels exceeding 1000 megarads, and in a few weeks it is possible to obtain irradiation doses equivalent to the highest which can be expected in a year's use of the products in a reactor.

Oil for Stability

Labour turnover rates in manufacturing industries (for four weeks ended 27 August 1960) are given in the *Ministry of Labour Gazette* for October 1960. The average for all the industries covered was, for number of engagements per 100 employed at the beginning of this period, 3·4, and for numbers of discharges and other losses, 2·6. The corresponding figures for the heading "Mineral oil refining" were 1·1 and 0·8 respectively, the lowest reported for any of the 108 industrial classifications covered.

Petrofina's New Bulk Depot

FULHAM INSTALLATION OPENED

Formally opened on 29 September by the Mayor of Fulham, Councillor Mrs F. C. Pusey, J.P., the latest Thames-side depot of Petrofina (Gt. Britain) Ltd at Carnwath Road, Fulham, provides increased distribution facilities for the Company's customers not only in the London area but for several miles around.

Covering an area of 3 acres, the depot has a total product capacity of 882,000 gallons of gasolines, diesel oil, kerosine, and domestic fuel oils. Supplies for the depot are delivered by barge from the Company's ocean storage installation at the river mouth. These barges are discharged by means of three Stothert & Pitt positive displacement rotary pumps capable of pumping 36,000 gph. A special discharge boom has been developed to connect barges and pumps.

Storage

For the storage of petrol and diesel oil beneath the loading bays a rectangular underground tank having a total capacity of 434,000 gallons has been constructed to LCC requirements. Surrounded by reinforced concrete 2 ft 6 in thick at the bottom, 1 ft 3 in thick at the sides, and 1 ft 6 in thick on top, this tank has five compartments. Two of these are of 250 tons capacity, two of 300 tons, and one of 400 tons, the latter being separated from the others by a concrete-filled bulkhead. The purpose of this is to minimize any risk of contamination between diesel oil and motor spirit.

Above-ground storage comprises three 500-ton tanks, 25 ft diameter and 48 ft high, and two 12,000-gallon horizontal cylinders and is used for high-flash material.

An overall view of the Fina depot at Fulham

All tanks were built by Whessoe Ltd, and all are fitted with Shand & Dewers level indicators to reduce the frequency of dipping.

Loading Bay

The road vehicle loading bay for diesel fuel and motor spirit is located above the underground storage tanks, there being one loading pump in each compartment. The pump mountings, tank manholes, vents, and dipstick pipes are in a common well in the centre of the yard.

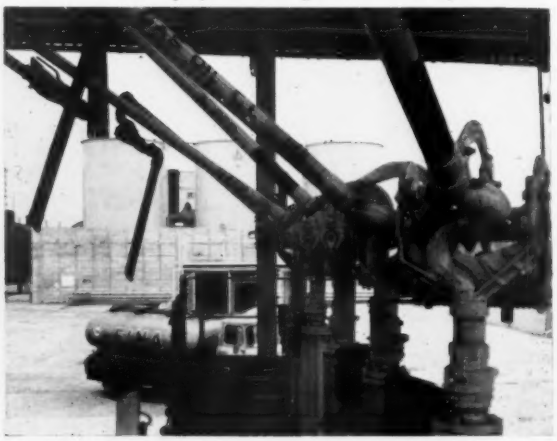
The pumps are of the submerged autrifugal type, each delivering 600 gpm to the bays, and were supplied by Rhodes, Brydon, and Yowatt. Control is by stop-start button on the gantry.

Loading pumps from the surface storage tanks are of the horizontal split casing centrifugal type rated at 300 or 600 gpm and supplied by Worthington-Simpson.

Vehicle loading equipment comprises Emco loading arms and Wayne-Smith rotary meters fitted with strainers, de-aerators, and set stop valves. The latter close at the pre-set

A general view of the loading bay

A close-up of the loading arms in the bay



quantity, having reduced flow to half speed at about 30 gallons short of the pre-set figure. Each meter has a ticket printing attachment.

Safety Precautions

The three large surface storage tanks have a central cooling spray device by which water from the mains or from a static water tank will flow over the roof and down the sides of the tank. Foam injection equipment outside the bund permits foam to be pumped to any tank when necessary.

All electrical equipment in the operational area is of flame-proof design. General electrical equipment and motor control gear are of industrial design and housed in a separate sub-station.

Other Facilities

A vehicle park has ample accommodation for 30 road tankers without overcrowding, and washing and general maintenance facilities are available for four vehicles. Office accommodation is adequate and modern in design and a rest room is provided for drivers.

An Emco Wheaton marine discharge boom off-loading a cargo of motor spirit delivered by barge from the Company's installation at the mouth of the Thames

M.O.A. Approved HD Oils

The following additional oils have been approved by the Director of Chemical Inspection, Ministry of Aviation, as complying with the requirements of Defence Specification DEF-2101.

Supplier and suppliers' nomenclature	*OMD grade of oil*
AB Nynas Petroleum:	
Nynas 13 DM 10W	40
Ajcol MS 30	110
Ajcol DM 50	330
BP Trading Ltd	
BP 2352	110
BP 2357	110
BP 2361	110
BP Trading Ltd (Australia)	
BP 2328	110
Berry Wiggins & Co. Ltd	
Chevron Tuscan 30	110
Beverol Fabrieken NV	
Beverol Gold HD SAE 20	60
De Cavel & Roegiers	
Elektriol HD	110
Deutsche Pentosin-Werke GmbH	
Pentosin motoröl HD SAE 30	110
Deutsche Shell AG	
Shell oil S 5518	110
Esso Petroleum Co. Ltd	
TSD 1230	110
GER Deurag Nerag	
Nerag motorenoel HD SAE 30	110
Gulf Oil (G.B.) Ltd	
Gulflube motor oil XHD 10W (G.B.M.)	40
Motor oil HD 50 (G.B.M.)	330
Manchester Oil Refinery Ltd	
Primor Mil 10W HD	40
Primor Mil 30 HD	110
Mobil Oil Co. Ltd	
—	40
—	110
Morris & Co. (Shrewsbury) Ltd	
Golden Film Ring Free 120	60
National Iranian Oil Co. Ltd	
Iranol SAE 30	110
Shell Co. of Australia	
Shell X100 motor oil 30	110
Shell X100 motor oil 50	330
Shell International Petroleum Co. Ltd	
Shell oil S.5699	40
Shell oil S.5701	60
Shell oil S.5703	330
Shell oil S.5830	110
Shell oil S.5832	40
Shell oil S.5833	330
Shell oil S.6003	330
Stevinson Hardy & Co. Ltd	
S.H. 19	110
Wintershall AG	
Salzbergener HD motorenoel CL SAE 30	110

Correction

Owing to a mistake in the MOA list the HD oil BP 2114, OMD grade 110, was attributed to Shell International Petroleum Co. Ltd in the *IP Review*, October 1960, page 321. It should appear under BP Trading Ltd.

New Distillation Pilot Plant for Birmingham University

PRESENTATION BY BAPCO

Recently added to Birmingham University's Chemical Engineering Department is a pilot-scale distillation plant for batch or continuous operation. It is a gift from The Bahrain Petroleum Company (Bapco), a member of the Caltex Group. It will be used for the investigation of petroleum distillation problems in general and for the preparation of special fractions for further study.

Designed by Bapco in conjunction with Metal Propellers Ltd, who fabricated the plant, it has a capacity of 50 gallons when operated as a batch unit or 5 gallons an hour (3 barrels per day) when used for continuous operation. Batch boilup rate for hydrocarbon materials is 10 gph and the continuous rate is 5 gph, the pressure range being 30 mm Hg abs to 150 psig. At the higher pressures it will be used only as a batch unit, but at low pressures or under full vacuum with or without steam, continuous feed and product-withdrawal is possible. Design temperature is 700 F maximum and stainless steel has been used throughout.

Those present at the ceremony included (left to right): *N. Craven Jones*, manager Midland Region, Regent Oil Co. Ltd; *R. J. Felgate*, engineer, Caltex Services Ltd; *S. K. Gold*, chief engineer, Caltex Services Ltd; *Prof. F. H. Garner*, head of Department of Chemical Engineering, University of Birmingham; *Prof. Stacey G. Ward*, Dean of University of Birmingham; *G. M. Murry, U.K.* resident director, Caltex Services Ltd; *L. G. Miskin*, Department of Chemical Engineering; *Prof. M. Stacey*, Deputy Dean and head of Chemistry Department, University of Birmingham; *Verdon P. King*, Caltex Services Ltd; *Prof. S. R. M. Ellis*, Department of Chemical Engineering; *P. E. Barker*, a member of the Distillation Group

The 8-in diameter column is packed with ½-in ceramic Berl saddles in three sections, the separating power of the column being equivalent to 15 theoretical plates. One side cut and an overhead product can be taken, and there are arrangements for steam stripping both bottom and side cut streams.

The plaque recording the donation of the unit

Heating is by electricity, the heaters and all control instruments being flame-proofed. Total electrical load is 40 kW in three phases.

A large vacuum pump is provided to handle noncondensable gases and a separate feed heater and flash vaporizer consists of a stainless steel coil in an induction-heated lead bath. The latter provides even heating up to about 800 F with a minimum risk of coking.

The operating platform is 10 ft above ground level, and the instrument panel carries all the necessary control gear except for the adjustment of the various pumps located at ground level. These latter can be provided with remote control. Except for pump adjustment and the handling of feed and product containers, the plant can be operated by one man.

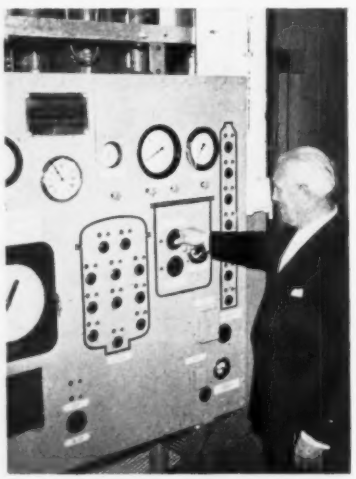
The unit requires overall headroom of 36 ft 6 in and the new pilot plant house in which it is located amply provides for this.

Handing Over

The unit was formally handed over on 14 September by G. M. Murray, U.K. resident director of Caltex Services Ltd, who said that the unit had originally been intended as a research and development facility for Bahrain. Changes of plans had later led to the decision to donate it to a university and Birmingham had been chosen for two reasons. The first was their close liaison over the years, in particular with Professor Garner, and secondly, the University was willing itself to provide a suitable building and to undertake the necessary electrical conversion work.

He felt sure that the Chemical Engineering Department would make good use of the unit.

Professor F. H. Garner expressed his thanks and those of the Department and the University for the very generous action of Bapco and the Caltex Group.



G. M. Murray at the control panel

World Tanker Statistics Third Quarter 1960

There were 251 oil tankers totalling 4,035,364 gross tons under construction throughout the world at the end of the third quarter of 1960. According to the recently-published *Lloyds Register Shipbuilding Returns* for that period 105 were steamships of 2,961,872 tons and 146 motorships of 1,073,492 tons.

Oil tankers accounted for 45·8 per cent of all merchant shipping under construction but compared with the previous quarter actual tonnage fell by 323,249 tons. It is interesting to note that the decrease on the total tonnage of merchant shipping—312,759 tons since the previous quarter—occurred entirely in oil tanker tonnage.

Tanker tonnage scheduled for registration in Britain however, rose by 109,816 tons to 59 ships of 1,115,300 tons. Liberia with 17 vessels of 526,457 tons due for registration and Norway with 29 vessels of 512,089 tons maintained their places in second and third positions behind Britain.

During the third quarter 52 tankers of 833,700 tons were being built in British yards which represented 47·5 per cent of the total tonnage under construction and was 61,475 tons

TABLE I

REGISTRATION OF OIL TANKERS UNDER CONSTRUCTION AT END OF SEPTEMBER 1960

Country of registration	*No*	*Gross tonnage*	*Country of build*	*No*	*Gross tonnage*
Britain	59	1,115,300	Britain... ...	47	728,600
			Commonwealth	1	21,000
			W. Germany ...	3	119,700
			Italy	1	23,000
			Japan	2	88,500
			Netherlands ...	2	52,500
			Sweden ...	3	82,000
Canada	1	4,000	Commonwealth	1	4,000
Other Commonwealth	1	18,200	Britain... ...	1	18,200
Argentina ...	2	3,000	Unspecified ...	2	3,000
Belgium	1	29,900	W. Germany ...	1	29,900
Brazil	3	21,600	Denmark ...	3	21,600
Chile	1	300	W. Germany ...	1	300
Nationalist China	2	4,800	Unspecified ...	2	4,800
Denmark ...	5	96,500	Belgium ...	1	13,000
			Denmark ...	4	83,500
Finland	2	13,367	Finland ...	1	499
			Netherlands ...	1	12,868
France	12	264,534	Denmark ...	1	21,500
			France... ...	10	214,034
			Netherlands ...	1	29,000
W. Germany ...	7	66,586	W. Germany ...	7	66,586
Greece	4	49,070	Netherlands ...	2	32,600
			Unspecified ...	2	16,470
Iran	1	33,705	France... ...	1	33,705
Iraq	2	500	W. Germany ...	2	500
Israel	1	16,100	W. Germany ...	1	16,100
Italy	21	372,670	Italy	21	372,670
Japan	29	59,644	Japan ...	29	59,644
Liberia	17	526,457	Belgium ...	1	31,200
			Denmark ...	2	59,600
			France... ...	3	100,405
			W. Germany ...	1	13,713
			Italy	1	20,760
			Japan	3	126,342
			Sweden ...	3	101,005
			U.S.A.... ...	2	55,602
			Yugoslavia ...	1	17,830
Netherlands ...	9	115,504	Belgium ...	1	30,000
			W. Germany ...	4	1,959
			Netherlands ...	4	83,545
Norway ...	29	512,089	Britain... ...	3	64,900
			Denmark ...	1	13,450
			France... ...	1	500
			W. Germany ...	3	72,500
			Japan	1	28,500
			Netherlands ...	1	500
			Norway ...	11	159,339
			Sweden ...	8	172,400
Panama	3	69,800	Italy	1	17,000
			Japan	2	52,800
Paraguay ...	1	1,070	Spain	1	1,070
Poland	2	26,368	Poland ...	1	12,868
			Yugoslavia ...	1	13,500
Portugal ...	3	19,140	Unspecified ...	3	19,140
Russia (U.S.S.R.)	3	19,130	Finland ...	1	3,330
			Poland ...	1	12,800
			Sweden ...	1	3,000
Spain	9	109,300	Spain	9	109,300
Sweden	6	126,230	Sweden ...	6	126,230
Turkey	1	420	Unspecified ...	1	420
U.S.A.	9	294,080	Netherlands ...	1	50,000
			Sweden ...	1	26,580
			U.S.A.... ...	7	217,500
Venezuela ...	1	22,000	Britain... ...	1	22,000
Yugoslavia ...	3	23,600	Yugoslavia ...	3	23,600
Unspecified ...	2	900	W. Germany ...	1	400
			Netherlands ...	1	500

Of the 251 oil tankers totalling 4,035,364 gross tons under construction 171 of 2,305,745 are for registration in country of build.

less than in the previous quarter. Sweden with 22 vessels of 511,215 tons and Italy with 24 vessels of 433,430 tons under construction remained in second and third places in the world's list of tanker builders. West Germany with 24 vessels of 321,658 tons however, dropped from fourth to sixth nation behind Japan and France. Table II gives a more detailed analysis.

British yards commenced work on 4 tankers during this period, launched 12, and completed 7. Japan commenced 50, launched 47, and completed 37. West Germany commenced 13, launched 9, and completed 8. Sweden commenced 7, launched 4, and completed 4. Details of launchings are given in Table III.

Two of the 251 tankers under construction in the world are of approximately 70,000 gross tons while a further three are between 50,000 and 60,000 tons. All those above 35,000 tons are fitted with steam turbines.

TABLE II

OIL TANKERS UNDER CONSTRUCTION AT END SEPTEMBER 1960

Country of build	*Steam*		*Motor*		*Total*	
	No	*Tons gross*	*No*	*Tons gross*	*No*	*Tons gross*
Great Britain and N. Ireland	26	652,456	26	181,244	52	833,700
Other Com'w'lth Countries ...	1	21,000	1	4,000	2	25,000
Argentina ...	—	—	2	3,000	2	3,000
Belgium ...	2	61,200	1	13,000	3	74,200
China (Nationalist)	—	—	2	4,800	2	4,800
Denmark ...	4	108,600	7	91,050	11	199,650
Finland	—	—	2	3,829	2	3,829
France	9	288,929	6	59,715	15	348,644
W. Germany ...	10	298,413	14	23,245	24	321,658
Greece	—	—	2	16,470	2	16,470
Italy	16	406,910	8	26,520	24	433,430
Japan	9	325,442	28	30,344	37	355,786
Netherlands ...	6	181,845	6	79,168	12	261,013
Norway ...	—	—	11	159,339	11	159,339
Poland	—	—	2	25,668	2	25,668
Portugal ...	1	17,560	2	1,580	3	19,140
Spain	2	43,000	8	67,370	10	110,370
Sweden	8	245,585	14	265,630	22	511,215
Turkey	—	—	1	420	1	420
U.S.A.	9	273,102	—	—	9	273,102
Yugoslavia ...	2	37,830	3	17,100	5	54,930
World total ...	105	2,961,872	146	1,073,492	251	4,035,364

TABLE III

OIL TANKERS LAUNCHED DURING THE THIRD QUARTER 1960

Country of build	*Steam*		*Motor*		*Total*	
	No	*Tons gross*	*No*	*Tons gross*	*No*	*Tons gross*
Great Britain and N. Ireland	3	89,611	9	55,891	12	145,502
Other Com'w'lth Countries ...	—	—	—	—	—	—
Argentina ...	—	—	1	1,500	1	1,500
Belgium ...	—	—	1	13,000	1	13,000
China (Nationalist)	—	—	—	—	—	—
Denmark ...	—	—	1	6,926	1	6,926
Finland	—	—	1	3,330	1	3,330
France	1	25,300	1	2,278	2	27,578
W. Germany ...	2	51,000	7	18,955	9	69,955
Greece	—	—	—	—	—	—
Italy	2	50,760	1	730	3	51,490
Japan	3	133,260	44	15,289	47	148,549
Netherlands ...	2	52,762	2	12,981	4	65,743
Norway ...	—	—	2	20,499	2	20,499
Portugal ...	—	—	1	1,340	1	1,340
Spain	1	21,000	—	—	1	21,000
Sweden ...	2	63,190	2	44,800	4	107,990
U.S.A.	5	128,602	—	—	5	128,602
Yugoslavia ...	—	—	1	1,800	1	1,800
World total ...	21	615,485	74	199,319	95	814,804

NEW BP REFINERY FOR BELFAST

The British Petroleum Company Ltd has announced plans to build an oil refinery at Belfast, Northern Ireland. Discussions have been in progress for several months with the Northern Ireland Government, and negotiations are now in progress with the Belfast Harbour Commissioners for a site on reclaimed land to the north-east of the existing oil storage installations in the Musgrave Channel of Belfast harbour.

The refinery will have an initial capacity for handling 1,300,000 tons of crude oil annually and will produce motor spirit, kerosine, aviation turbine fuels, light and heavy diesel oils, fuel oil, and liquefied petroleum gas. The products manufactured in this refinery will be marketed in Northern Ireland by Shell-Mex and B.P. Ltd and will provide a margin for export. Crude oil will be imported in tankers up to 32,000 dw tons.

Site preparation is expected to begin in the spring of 1961 and actual construction work later in the year. It is estimated that the project will take about two years to complete, and during construction the labour force will rise to a peak of about 1400.

It is expected that this, the first oil refinery in Northern Ireland, will require an initial investment of about £8 million.

An artist's impression of the refinery when completed

Lectures, Courses, and Conferences

Quality Control Symposium

A symposium on quality control organized by the Quality Control Division of Elliott Brothers (London) Ltd to introduce new developments in the field, and the Company's range of quality control instruments, was given at Caxton Hall, Westminster, on 22 September.

The first paper was given by Dr D. J. Fraade, M.Sc., director of the Analytical and Control Instrument Division of Consolidated Electrodynamics Corp. The title was "Applications of On-Stream Analysis Instruments to Control in the U.S.A."

Details were given of two successful applications of closed-loop process control based upon stream analysis, and involving continuous process chromatography and continuous detection of moisture.

Initial drawbacks to using the continuous process chromatograph have now been obviated with the development of high-speed chromatography where analysis cycles were in the order of one minute or less for components in the C_5 range.

Dr Fraade described one of the most universal applications, which has been in natural gasoline plants, at the Reef Corp, Texas. In a process chromatograph and a pneumatic control system the analyser samples the bottom product of the de-ethanizer for ethane as an impurity, and controls the ethane content to a feasible and allowable maximum so that the overhead propane product from the downstream depropanizer meets the vapour pressure specification. Revenue is gained by the sale of the liquefied natural gas products removed from the gas in the oil wells, and the uncondensed portion of the gas is also sold.

The monitoring of trace moisture was then discussed, together with the recent introduction of a continuous part-per-million detector based upon the du Pont patent issued to Dr F. Keidel for the electrolysis of water absorbed on a desiccant coated electrode, which has many sorts of application.

The second paper was given by J. Barnes, M.A., of E.A. Automation Systems Ltd, on the use of an on-stream analyser and optimat controller in optimizing the performance of a distillation column. The Elliott electronic device automatically maintains the best operating conditions for manufacturing a product of consistently high quality in an industrial process plant. In the past, the approach to such problems had always involved the use of highly complex computing equipment designed to control the plant on the basis of plant characteristics, previously determined, and stored in the computer memory in mathematical form. Unfortunately it was frequently impossible to obtain mathematical information about manufacturing processes and it was often extremely costly to evaluate such basic information as was available.

A field trial of the instrument is being prepared at one of the U.K. refineries. The aim of this trial is to obtain the maximum output from part of the plant whilst continually preserving the quality of the refined spirit so that it meets an agreed specification. In this system the refined spirit will be continuously analysed by means of a process chromatograph.

The last paper, given by R. L. Botting of the Elliott-Fisher Governor Company, dealt with "In-Line Blending Systems Employing Continuous Control of Viscosity or Density". The basic mechanism used by Fisher for such systems proportions the two components of the blend by automatically regulating the line pressures to maintain equal differential pressures across individual orifices. The relative proportions of the components can be continuously changed by adjustment of the orifice area ratio control, and the process was fully described. This instrument, developed by the Shell Development Co. of America, is now being marketed by the Quality Control Group of Elliott Brothers, who will also supply the control system. In view of the high accuracy of quality control made possible by this system, it is expected that the use of in-line blending systems will extend rapidly with consequent economies both in the product and in capital equipment.

The author, in conclusion quoted staff at the Shell Refinery in Houston, Texas, which uses both types of control as saying that control had been sufficiently good to result in savings estimated at $90,000 per year attributable to viscosity control only, plus a further $100,000 per year attributable to the addition of gravity control.

Hovercraft Lecture

A special lecture on "Hovercraft" will be given by R. A. Shaw, O.B.E., M.A., F.R.Ae.S. assistant director of aircraft research of the Ministry of Aviation, at the Royal Aeronautical Society, 4 Hamilton Place, London, W.1, on 17 January 1961.

The Lecture has been arranged by The Institution of Plant Engineers, from whom admission tickets must be obtained by application to their Secretary at 2 Grosvenor Gardens, London, S.W.1. The lecture commences at 7 p.m., preceded by tea at 6.30 p.m., and members of the Institute of Petroleum are invited to attend. Applications must be marked Special Winter Lecture (IPE/P).

* * *

MIDDLE EAST OIL PRODUCTION

	September	*Jan-Sept*
	Tons	
Iraq Petroleum Co. Ltd ...	3,035,157	24,809,979
Basrah Petroleum Co. Ltd ...	993,789	8,547,232
Mosul Petroleum Co. Ltd ...	105,469	974,693
Qatar Petroleum Co. Ltd ...	663,322	6,057,238
Iraanse Aardolie Exploratie en Productie Mij	4,422,000	36,627,000
Kuwait Oil Co. Ltd	7,037,111	59,921,786
	Barrels	
Arabian American Oil Co. ...	37,472,758	332,427,635
Bahrain Petroleum Co. Ltd ...	1,352,300	12,349,993
Getty Oil Co. and American Independent Oil Co. (Kuwait-Arabia Neutral Zone) ...	4,183,597	35,868,220

The refinery throughput at Abadan of the Iraanse Aardolie Raffinage Mij for September was 1,371,000 tons, the total for 1 January to 30 September being 12,688,000 tons.

Crude processed at Aramco's Ras Tanura refinery during September was 7,562,629 brl, the total for 1 January to 30 September being 61,369,274 brl.

Combustion Research by BP

EXPERIMENTAL BOILER PLANT AT ISLE OF GRAIN

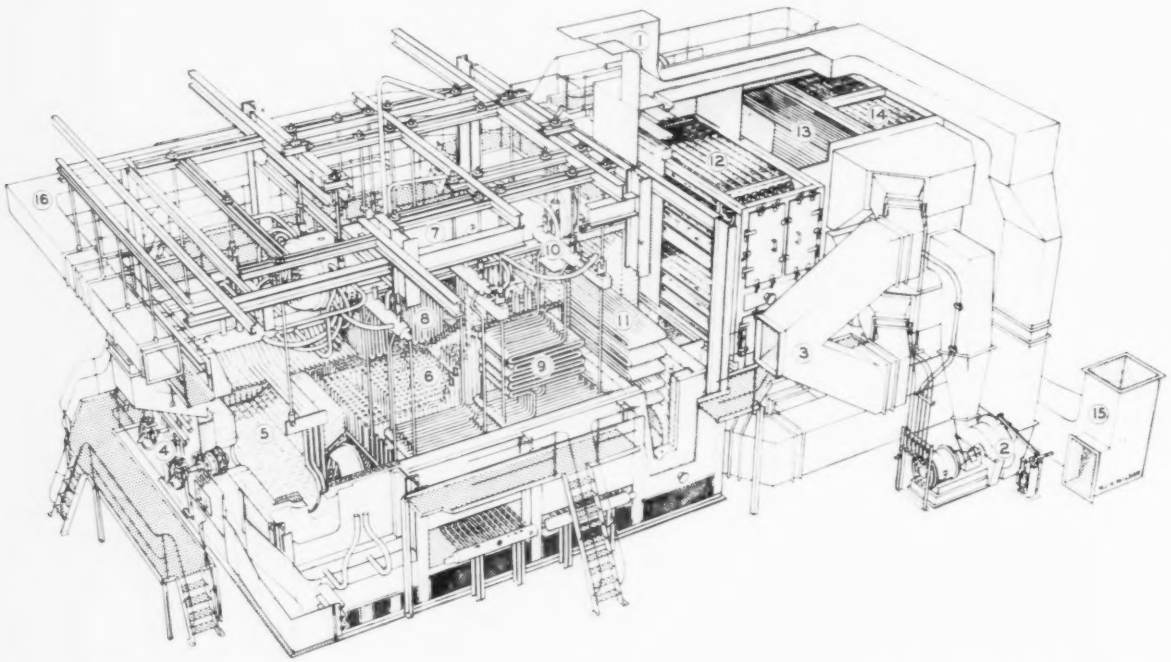
For some years The British Petroleum Company's research organization has been engaged on problems of high and low temperature corrosion in boilers. At the same time it has also been investigating the associated problem of air pollution from boiler stacks.

The initial research was carried out at the Company's Research Centre at Sunbury-on-Thames. This was followed by trials on full-scale boilers made available for the purpose by industries in the United Kingdom and other European countries. In these trials other research bodies and plant manufacturers frequently collaborated. The results of the work were reported to the Fifth World Petroleum Congress, in a paper on "Fire Side Corrosion in Oil-fired Boilers" by L. K. Rendle, R. D. Wilsdon, and G. Whittingham.

The Company's investigation of these problems has contributed to the knowledge necessary to effect improvements in super-heaters and super-heater supports. From the extensive study of low temperature corrosion problems has come a method of controlling the effects of acid on heat exchangers by the use of ammonia gas injected into the low temperature zone of the flue gases. Another important result of the work was the development of the technique of shielding metal chimneys with aluminium to reduce or eliminate the emission of smuts and chimney corrosion.

The initial investigations and the subsequent field trials carried out to date have yielded extremely valuable results. However, it became clear that complementary to these trials experiments on a full scale basis would have to be conducted with a boiler installation under the complete control of the research team. The Company therefore decided to install its own water tube boiler on a site adjoining its refinery on the Isle of Grain, Kent.

This location enables purified feed-water and fuel oil of the required specification to be drawn from the refinery, and the steam produced to be piped back to the refinery system for use. Also the small specialized laboratory and workshop provided for the plant can be supplemented as needed by the more extensive facilities of the refinery.

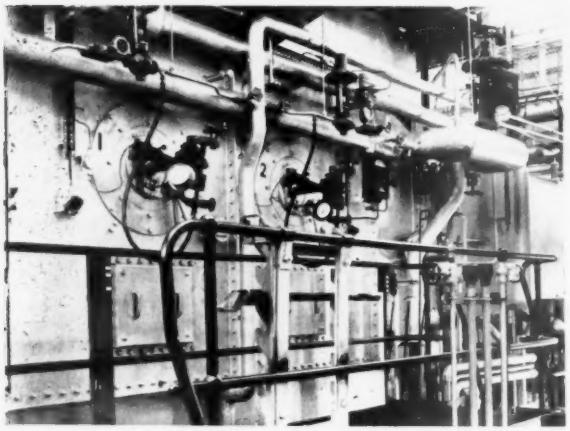


1. *Combustion air intake*
2. *Forced draught fan*
3. *Hot air duct to windbox*
4. *Firing point*
5. *Combustion chamber*
6. *Generator bank*
7. *Steam drum*
8. *Pendant superheaters*
9. *Horizontal superheaters*
10. *Superheat control damper*
11. *Rear boiler bank*
12. *Green's CI economizer*
13. *B and W steel tube air heater*
14. *Green's CI air heater*
15. *Duct leading to i.d. fan*
16. *Gas recirculation duct*

Cutaway view of experimental boiler for BP Kent Refinery

The following are notes on technical details:

The Boiler, designed to BP specifications by Babcock and Wilcox Ltd, is capable of producing 20,000 lb of steam per hour at 350 psig and 1200 F when operating under high temperature conditions, or 30,000 lb per hour at 175 psig and 480 F under low temperature conditions. It is of a specially designed two-drum water tube type, with an economizer, air heaters, and flue-gas recirculation system. The combustion chamber (of which the roof and sides are water-cooled) leads to three gas-passes, of which the centre contains the steam-generating system, and the two outer ones contain the super-heaters. In one of these the tubes are vertical and in the other horizontal, so that the fouling and corrosion in both types can be observed. The steam passes through pressure-reducing and desuperheating equipment (supplied by Hopkinsons Ltd) before being led to the refinery. The boiler has a guaranteed gross thermal efficiency of 88 per cent.



The side of the boiler showing the two pressure jet burners in position

The Economizer is a cast-iron gilled tube Premier Diamond Type 25 supplied by E. Green and Son Ltd.

Air Heaters—One of cast-iron by E. Green & Son Ltd and one in steel by Babcock & Wilcox Ltd, so that conditions in both types can be studied. They are arranged in two tiers and the air can be circulated in parallel or counterflow as required. The gas can be wholly or partly by-passed from either as desired. The exit gas temperature is 217 F.

Firing—Oil firing equipment was supplied by Hamworthy Engineering Ltd. Fuel up to 6000 sec Redwood I at 100 F is delivered at pressures up to 500 psig by two electric positive-displacement pumps to two pressure jet burners.

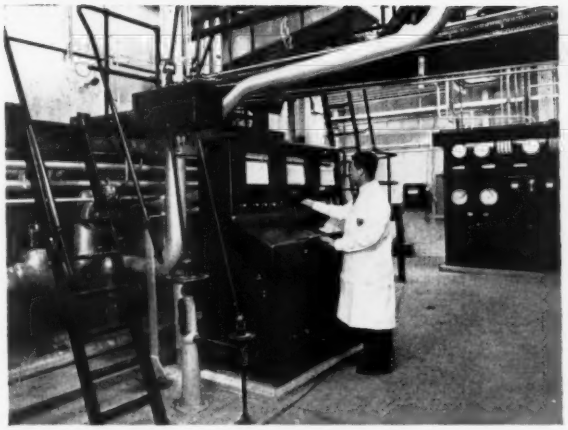
Fuel Tanks are insulated with fibre-glass and aluminium cladding, retained by studs welded to the tank. There are: two of 5000 gallons capacity, one of 750,000 gallons, and one of 150,000 gallons.

Draught—Electrically driven fans by Davidson & Company provide forced or induced draught. The induced draught fan is fitted with a fluid coupling and may be by-passed if natural draught is required.

Chimney Stack—150 ft riveted steel, built with acid-resistant firebrick.

Feed-Water is supplied by a vertical direct-acting pump by G. & J. Weir Ltd with a capacity of 30,000 lb an hour, with a duplicate stand-by. A high pressure heater can raise the total feedwater from below 200 F to 330 F. A spray water heater can raise 10,000 lb of water per hour from 60 F to 300 F for desuperheating purposes.

Instrumentation is of pneumatic type by Bailey Meters & Controls Ltd. In addition to the normal instruments used in boiler operation, there is a fully automatic control system incorporating various safety devices, among which may be mentioned a newly-developed acoustic type of flame-failure equipment.



The central instrument panel. By means of a "telephone exchange" type network any observation made on any part of the boiler can be recorded automatically

Collection of Research Data. There are 25 probe-holes in which instruments can be inserted for research observations. In addition to the control panel, there is a second panel for temperature observation on which are three millivoltmeter recorders. These can be connected to any of 15 stations.

The plant is now in full operation.

THE EMPLOYMENT OF THE SMALLER OCEAN TANKER

Westinform Shipping Report No 166 looks at the composition of the current world tanker fleet of vessels of under 20,000 tons, orders for tankers in that size group, and the activity of a sample of vessels not engaged in spot trading.

The current fleet is analysed by age, ownership, and size, and significant differences between the fleets owned by oil companies and those owned by independent operators are revealed, in particular the much greater relative importance of T2s to the oil companies. A survey of laid-up vessels shows T2s as accounting for more than one-third of the total.

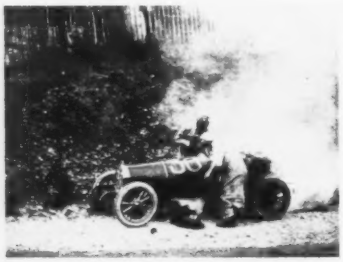
Vessels now on order are summarized in tabular form and related to the total world tanker order book, showing that, although the fleet of under-20,000-tonners will become smaller both relatively and absolutely, it will soon be much more modern. Finally a survey is made of the activities of a sample of under-20,000 tonners for which no fixtures were reported between January 1959 and March 1960 inclusive. This is complementary to the summary of fixtures during that period mentioned above, with which comparisons are made. The results of the present survey are presented in the form of tables showing the relative importance of major routes for both independent and company-owned tankers.

Copies of this report can be obtained from W. G. Weston Ltd, 26–27 Cockspur Street, London, S.W.1, at a cost of £2 each (postage extra).

Books and Films

Motor Racing and Consumer Service

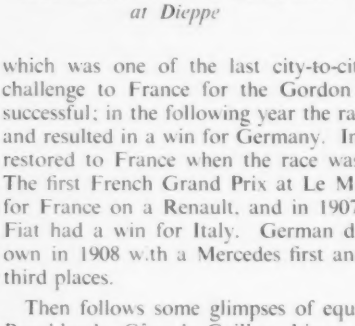
The thrills and spills of motor racing are nowhere brought out better than in Shell's latest film *The Heroic Days*, which was given its premiere on the occasion of the annual reception by Shell-Mex and B.P. Ltd during the Motor Show. The first part of a history of motor racing, but a complete story in itself, it is compiled from films of actual events and reports and in 32 minutes covers from the 1902 Paris-Vienna race up to the 1914 French Grand Prix.



An unscheduled stop during the 1908 Grand Prix des Voiturettes at Dieppe

In the 1902 race, which was one of the last city-to-city events, the British challenge to France for the Gordon Bennett Trophy was successful; in the following year the race was held in Ireland and resulted in a win for Germany. In 1904 the Trophy was restored to France when the race was held in the Taunus. The first French Grand Prix at Le Mans was won by Szisz for France on a Renault, and in 1907 Felice Nazarro on a Fiat had a win for Italy. German drivers came into their own in 1908 with a Mercedes first and Benz in second and third places.

Then follows some glimpses of equally exciting racing at Brooklands, Côte de Gaillon, Limonet, Shelsley Walsh, on trotting tracks in the United States, and on the sands at Weymouth. The Grand Prix story is taken up again with the 1911 Le Mans and continues until the 1914 event where is seen a dramatic struggle between France and Germany, with the defeat of the French driver on the last lap.



The island of Skiathos

Also given its premiere on the same occasion was *Mikhali*, a BP film photographed on the island of Skiathos in the Northern Sporades Group off the Greek mainland. Mikhali is a BP agent on the island which has no roads and therefore no cars. It must be a wonderful place. Mikhali's main business is to supply fuel to the fishing fleet and butane for cooking purposes. He is also the local ships chandler. Printed in Technicolor, the film runs for 38 minutes and is part of the pattern of BP's current film production in which stress is placed on those in the oil industry whose jobs bring them directly in touch with the public.

The Construction of the Doncaster By-Pass

The sole link between the M1 motorway and the old A1 is being built around Doncaster. This by-pass not only serves to join the two main highways but also to relieve the extremely severe traffic congestion in the highly-industrialized Doncaster area.

The construction consortium of Cubitts, Fitzpatrick, Shand, are responsible for the work on the by-pass, and Regent Oil Co. Ltd, in the first film to be written, filmed, and produced by the Company's own staff, have illustrated how the virgin ground was prepared for road construction in the first year. The scenes of clearing, blasting, and excavating are described by Franklin Engelmann, and the work of the Regent fuel and lubricants service is shown. All vehicles on site are supplied by mobile fuel bowser equipped with a 30-ft boom. Static machinery are equipped with their own barrels and pumps. Bulk storage of products was built on-site. Every week some 15,000 gallons of fuel was supplied to approximately 500 machines.

The 110 RB excavator being fuelled by a bowser similar to those used in fuelling aircraft. This is the only method by which a machine of this size can be fuelled speedily and economically

The film, *Beating the Romans*, is in 16 mm Kodachrome colour, and runs for 20 minutes. The final stage of work on the by-pass is scheduled for completion by mid-1961, and this will be filmed to combine into a 35-minute production covering the entire project.

Copies of the film are available for loan on application to Regent Oil Co. Ltd, 117 Park Street, London, W.1.

A Fuel Efficiency Diary

A useful diary for 1961 is the Industrial Fuel Efficiency Pocket Diary which contains as a preliminary about 100 pages of useful information relating to fuels (including oil) and the production and use of steam and power in industry. The diary section is arranged one week per page. Priced at 10*s* 6*d* in morocco grain leather and 13*s* 6*d* in real pigskin, it is published by H. O. Quinn Ltd, 151 Fleet Street, London, E.C.4.

Report of the European Federation of Corrosion

The Annual Report for 1959 of the European Federation of Corrosion provides information on the technical work on corrosion carried out in Europe, with particulars of addresses and publications, research projects, and papers read at meetings.

It is divided into three parts. The first part presents the report of the General Secretariat and gives an account of

activities within the Federation; the second contains reports from the 52 member societies in 17 European countries on their technical work in the field of corrosion; and the third gives a survey of the institutes and research centres concerned with the problems of corrosion and the protection of construction materials.

The report can be obtained from the General Secretariat of the Federation, Büro, Frankfurt (Main), Postfach 7746. The price to members of societies affiliated to the Federation is DM 15, and to non-members DM 30 including forwarding charges.

Coke Research Report

The Sixteenth Annual Report, for 1959, of the British Coke Research Association is now available. Accounts are given of the various schemes of work in the laboratories, test plant, and of that in progress at research departments of the universities.

The work done at the BCRA test plant during 1959 included studies on the composition of the benzole produced by the 10-ton test oven plant. The development of the technique of gas-liquid chromatography and the facilities offered by the plant enabled the compositions to be studied in detail for the first time. The work was undertaken jointly by the Association and Benzole Producers Ltd.

One of the studies of an *ad hoc* nature made during the year at the Applied Studies Laboratories was on the use of the Sheffield high-temperature method for the determination of sulphur in fuel oils. A paper on this subject will be published.

MASS SPECTROMETRY CONFERENCE

The Mass Spectrometry Panel of the Institute of Petroleum in conjunction with ASTM Committee E-14 are organizing a conference of Mass Spectrometry which is to be held at Oxford University on 12–15 September 1961.

Papers dealing with any aspect of mass spectrometry will be welcome but special sessions will be held which will deal with high resolution mass spectrometry, the mass spectrometry of organic compounds, and the mass spectrometry of inorganic solids.

Authors who wish to present papers at the Conference are asked to send full abstracts by 28 February 1961 to Dr R. R. Gordon, chairman, Mass Spectrometry Panel, National Coal Board, Coal Research Establishment, Stoke Orchard, Cheltenham, Gloucestershire. The final choice of papers to be presented will be made by a reviewing committee on the basis of the abstracts submitted.

It is intended that pre-prints of papers shall be sent in advance to all conference members. For this reason complete papers will be required by 31 May 1961. The proceedings of the Conference, including discussion, will be published by Pergamon Press.

Accommodation for Conference members will be available in Oxford Colleges under arrangements which have already been made. A reception will be held on the evening of 11 September and a conference dinner on 14 September. It is hoped to arrange some visits or excursions during the Conference including a visit to the Shakespeare Memorial Theatre, Stratford-on-Avon. Further information about the Conference can be obtained from W. J. Brown, Instrument Division, AEI (Manchester) Ltd, Trafford Park, Manchester 17.

* * *

ELECTRICAL POWER IN ENGLAND

The Annual Report and Accounts 1959–60 of the Central Electricity Generating Board announces that present plans suggest that in 1965 nuclear energy and oil will each contribute approximately 10 per cent of the Board's total energy requirements. Solid fuel will supply the remainder, and it is anticipated that the coal burnt in that year will be some 8–10 million tons above the present level of 43·4 million.

Total fuel used in the Board's stations in England and Wales during the year was 52,491,000 tons of coal equivalent. This was 8·6 per cent more than in the previous year, and included 4,527,000 tons of oil—7,977,000 tons coal equivalent. The oil content showed an increase of 1,299,000 tons, (2,336,000 tons coal equivalent). A more detailed picture is given in the accompanying table.

It is reported that as abundant supplies of coal were available during the year representations were made to the Board to reverse earlier decisions to burn oil at certain power stations. In spite of considerable difficulties, the expense of conversion or reconversion, and the fact that contractual obligations with oil suppliers had been made, the Board—assisted by the Government and the oil companies—was able to modify their earlier plans. As a result the conversion of some stations to burn oil has been further postponed, in spite of the fact that present day oil prices show a substantial economic margin over coal at these stations.

In the nine large power stations using only oil as fuel there were 2,485,000 kw (installed) of steam plant at 31 March 1960. The stations in question were Bankside B (London), Belvedere (London), Bromborough, Ince (near Ellesmere Port), Littlebrook C (Dartford), Marchwood (near Southampton), Poole, South Denes (Yarmouth), and Tilbury. Heavy fuel oil supplies were delivered mainly in coastal tankers, but two Merseyside stations—Bromborough and Ince—were supplied by pipeline direct from the refinery.

For all fuels, the cost of heat fell from 4·087*d*/therm in 1958/9 to 3·890*d*, or 4·8 per cent, part of the reduction being due to the greater use of fuel oil and the decrease in oil prices.

FUEL USED IN POWER STATIONS IN ENGLAND AND WALES

Thousand tons

Year Ended March	*Coal*	*Coke breeze*	*Oil*				*Other fuel (Coal equivalent)*	*Total fuel (Coal, coke breeze, and coal equivalent)*
			*For steam raising**	*For diesel plant †*	*Total oil*	*Total coal equivalent*		
1948	23,856	197	23	12	35	59	96	24,208
1954	33,963	851	89	12	101	174	64	35,052
1958	43,803	806	901	12	913	1,589	52	46,250
1959	41,691	982	3,216	12	3,228	5,641	37	48,351
1960	43,431	1,076	4,512	15	4,527	7,977	7	52,491

* Comprising heavy fuel oil used in oil-fired boilers, and oil used for lighting up pulverized fuel boilers. In 1959–60, the former accounted for 4,394,000 tons, equivalent to 7,741,000 tons of coal. This was an increase of 1,274,000 tons on the previous year (2,290,000 tons coal equivalent) and resulted from arrangements first made in 1954–5 to burn oil at a number of power stations.

† As from 1954 this includes small quantities used in gas turbines.

Trade Literature, etc.

Lubeoil Detergent Additives

Reprints of an article explaining the use of Nadone *cyclo*-hexanone as a lubricating oil detergent additive are available from Allied Chemical International. Cyclohexanone, an industrial solvent, increases the normal life expectancy of aircraft engines by preventing hard carbon and sludge, reducing engine smoke, oil leak maintenance, and starter and generator oil retainer seal replacements.

Author of the article is Lt-Col R. L. Selman, Office of the Inspector-General, United States Air Force.

Copies may be obtained from Allied Chemical International, 40 Rector Street, New York 6, NY.

Cannings' Mechanical Seal

The "J.6" mechanical seal with a rotating face seating against a stationary face at right angles to the shaft, leak-proof under all conditions of reversible and pulsating pressures and vacuum, is announced by J. A. Cannings Ltd, Bathwick, Bath.

Able to run dry continuously without over-heating, the seal is ideal for drawing volatile spirits from barges, or for any other duty where temperature rise at the seal faces or power absorption is important. It can be supplied for external or internal fitting as a self-contained unit requiring neither lubricant nor coolant, and is capable of standing up to speeds of 3000 ft/min.

Dry Air Application Counters Tanker Hold Corrosion

By the continual pumping of dry air into a ship's compartments before and whilst restoration work on the interior of a ship's hold is in progress, it has been found that the atmosphere remains free of all moisture and thus prevents impediment of the reconditioning treatment.

In recent experimental work by Seaguard Ltd a Birlec model CR dehumidifier was installed on the dockside and ducting arranged between the unit and the five tanks on each side of the tanker's centre line bulkhead. Dry air was fed to compartments at the rate of 1500 cu ft/min and extractors were installed to work at the same rate.

Standard Birlec dehumidifiers are available for delivery of dry air in quantities of up to 15,000 cu ft/min. The equipment uses silica gel or activated alumina to remove the water vapour from the air. Further details are available from AEI-Birlec Ltd, Tyburn Road, Erdington, Birmingham 24.

Acheson Dispersions Booklet

The list of standard dispersions produced by Acheson Colloids Ltd, P.O. Box 12, Prince Rock, Plymouth has been revised and reprinted for the first time in booklet form. Entitled *Acheson Dispersions* it classifies 38 dispersions in seven main groups. The technical data given include carrier liquid, approximate solids content, density, diluent, and flash point.

Pump Contracts for Tankers

Hayward Tyler & Co. Ltd, 24 Crawley Green Road, Luton has been awarded the contract for three vertical centrifugal cargo pumps for a Shell tanker building at Furness, and one vertical centrifugal ballast pump. Each pump will be driven by Hayward Tyler-De Laval 800 hp vertical geared steam turbines.

An order for a BP Tanker Co. Ltd vessel by John Brown of Clydebank consists of three horizontal centrifugal cargo pumps driven by Hayward Tyler-De Laval horizontal steam turbines together with one horizontal self-priming centrifugal ballast pump. The combined value of these contracts is approximately £55,000.

New Perkins Diesel

An industrial version of the new Perkins Six 354 direct-injection diesel engine suitable for all stationary and mobile plants, is rated up to 112 bhp at 2800 rev/min for industrial use when fitted with an hydraulic governor and used for suitable intermittently-rated applications such as fork lift trucks and other mobile equipment. At this rating it develops maximum torque of 260 lb/ft at 1450 rev/min.

The combustion chambers are toroidal shaped bowls formed in the top of the pistons and slightly offset from centre. Fuel is injected directly into the cylinders through multi-hole atomizers.

New Arca Products

New additions to the range of control equipment manufactured by British Arca Regulators Ltd, Sisson Road, Gloucester, are the *Uniflow* 800 series Barstock diaphragm-operated valve available from ¼–1 in for pressures up to 60,000 psi, and their series 52 receiver controller for use with pneumatic transmitters with an output pressure range of 3–15 psi.

Kestner Evaporators

A new fully-illustrated loose-leaf brochure is available from the Kestner Evaporator and Engineering Co. Ltd, 5 Grosvenor Gardens, London, S.W.1. Its contents are divided into 14 sections which describe the nature of the Kestner climbing film evaporator and the ancillary plant such as heat exchangers, coolers, condensers, and vacuum raising equipment. Tables give pertinent hydrometer scales and the properties of saturated steam.

Maleic Anhydride Plant to Use SD Process

Rheinpreussen AG, Homberg, Neiderrhein, Germany, will build a maleic anhydride plant using the Scientific Design process of fixed-bed, catalytic, air oxidation of benzene. The plant, to be built at Meerbeck, will have an initial design capacity of 13·2 million lb/year of maleic anhydride. Scientific Design Company will provide complete process design, process engineering, general engineering, and major equipment design.

Recent Cambridge Instruments

Recent brochures issued by Cambridge Instrument Co. Ltd, 13 Grosvenor Place, London, S.W.1, include those describing the *Numalec* programme controller for temperature/draught or pressure; an electronic self-balancing recorder designed to select and scan from 20 to 400 points; and the Cambridge pneumatic temperature measuring system. Other publications feature the controllers based on the electronic self-balancing recorder; and the Company's complete range of draught and pressure instruments.

Inco-Weld 'A' Electrode and Filler Wire

For many years it was the general rule that in the welding of dissimilar metals the filler metal should match the higher alloy of the metals being joined. Although this proved satisfactory for some combinations there are instances when undesirable deposits have resulted from the filler metal being diluted with the lower alloy base metal.

Henry Wiggin & Co. Ltd, Wiggin St, Birmingham 16, have now issued a booklet which explains with tables and illustrations, how their *Inco-Weld 'A'* electrode and filler wire overcome these difficulties.

New Regent Anti-Freeze

Regent Oil Company Ltd have introduced a new Regent PT Anti-Freeze two-phase ethylene glycol base premium-type anti-freeze with selected inhibitors. It is foam-resistant and contains a second oil phase which doubles the protection of the cooling system against corrosion. The new product has already proved itself operationally in Canada and the U.S.A.

Leybold-Elliott Ltd

This is a new company recently formed jointly by Elliott Brothers (London) Ltd and Leybold's of Cologne, high-vacuum engineers. It is the purpose of the new enterprise to introduce modern high-vacuum plants for many purposes, including distillation, impregnation, and leak detection.

Recently the new Company held an exhibition of methods and machinery for producing high-vacuum including oil diffusion pumps (30–8000 litres/sec), Roots pumps, gas ballast pumps, and rotary pumps (2–720 cu m/hr). Models were also exhibited of a molecular distillation plant for the distillation of sensitive organic substances in vacuum at the rate of 875 kg/hr, a model of a cable impregnated plant and a model of a freeze drying plant for scientific research. It was mentioned that with an oil diffusion dump pressures of 10^{-5} mmhg could readily be obtained.

British Contract for Abadan Unit

A contract worth nearly £2 million recently placed by Iranian Oil Refining Company for a 20,000 bd UOP Unifiner-Platformer for Abadan is being carried out by Fluor Engineering & Construction Co. Ltd.

Design, detailed engineering, and purchasing has already begun, and construction will get under way early next year. Completion is scheduled early in 1962.

Griffin & George in Manchester

The official opening of the new northern sales and service centre of the Griffin & George Group at Ledson Road, Wythenshawe, Manchester 23, was held on 10 October.

★ ★ ★

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INSPECTOR of Explosives: Home Office. Pensionable post in London for man or woman at least 30 on 1.11.60 with degree (preferably 1st or 2nd class) in chemistry or chemical technology, or equivalent qualification. Experience of the working of an explosives factory or in petroleum industry an advantage. Duties involve travel to all parts of the country, and include advising on safety precautions for manufacture, storage, and conveyance of explosives; inspecting premises licensed for manufacture and storage; advising on safety precautions for storage and conveyance of petroleum and other dangerous substances. London salary scale: £1,470—£2,080. Starting salary may be above minimum. Promotion prospects. Write Civil Service Commission, 17 North Audley Street, London, W.1. for application form quoting **S 5234/61.** Closing date 10th January 1961.

Disposable Paper Wipers

Latest addition to the Kimberley-Clark range of paper products for industry is Kimwipes, a disposable paper wiper which can be used for many purposes where a dust- and fluff-free wiper is required. Thus, in the laboratory for the cleaning of instruments and glassware this product should be of particular value. In many oil industry activities where clean wiping is required there should be much scope for the use of Kimwipes.

A Kimwipe in laboratory use

Most oilfields have their own hospital and another new Kimberley-Clark product—the Kleenex Dressing Towel—should be of interest. As a sterile towel it appears to have many uses and an added advantage that, being disposable, no laundering charge is incurred. It is available in two sizes in perforated rolls of 100 towels each.

Full details of these products are available from Kimberley-Clark Ltd, Larkfield, Maidstone, Kent.

★ ★ ★

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London, S.W.1.

Forthcoming Meetings

THE INSTITUTE

(At 61 New Cavendish Street, London, W.1, 5.30 p.m.—tea 5 p.m.)

The Changing Energy Pattern in Europe and its Possible Effect on Product-Mix. M. E. Hubbard, B.A., M.I.Mech.E., M.Inst.F. **7 December**

Preflame Reactions in Diesel Engines, Part V. Prof. F. H. Garner, O.B.E., Ph.D., F.R.I.C., M.I.Mech.E., M.I.Chem.E., Prof. F. Morton, M.Sc.(Tech), Ph.D., D.Sc., F.R.I.C., M.I.Chem.E., and J. B. Saunby, B.Sc. **4 January**

IP ESSEX BRANCH

(At Bull Hotel, Pitsea, 7.30 p.m.)

Brains Trust. **14 December**

AGM (7 p.m.). **RAF Competition: London–Paris Race** (8 p.m.). **18 January**

IP FAWLEY BRANCH

(At the Potters Heron Hotel, Ampfield)

AGM and Film Show. **11 January**

IP LONDON BRANCH

Dinner Party. **24 January**

IP NORTHERN BRANCH

(At Engineers' Club, Albert Square, Manchester 2, 6.30 p.m.)

Railway Dieselization and Electrification. **17 January**

IP SCOTTISH BRANCH

(At BP Refinery Recreation Hall, Grangemouth, 7.30 p.m.)

AGM (7 p.m.). **Weather.** W. Gray, M.A., B.Sc., F.R.Met.S. **19 January**

IP SOUTH WALES BRANCH

(At the Training Centre, BP Refinery (Llandarcy) Ltd, 5.30 p.m.)

Philosophy and Practice of Lubricants Quality Control. J. H. Harris. **15 December**

Fuels for Rocket Propulsion. R. P. Hagerty, B.Sc., Ph.D., A.R.I.C. **19 January**

IP STANLOW BRANCH

(At Administration Offices, Stanlow Refinery, 5.30 p.m.)

Life in an Overseas Refinery. A. B. Crowe, B.Sc. **14 December**

(At Lecture Theatre, Grosvenor Museum, Chester)

AGM (7 p.m.). **The Monte Carlo Method.** Prof. R. W. Revans, B.Sc., Ph.D., M.Sc.Tech. (7.30 p.m.). **18 January**

IP YORKSHIRE BRANCH

(At Great Northern Hotel, Leeds, 7 p.m.)

AGM. Address by the President. J. M. Leonard, M.I.Chem. E. **8 February**

SOCIETY OF CHEMICAL INDUSTRY

(Road and Building Materials Group)

(At the Lecture Hall, 14 Belgrave Square, London, S.W.1., 2.30 p.m.)

The Use of a Microviscometer for Measuring Viscosity of Bitumens. F. A. Wadelin. **15 December**

PIPELINE INDUSTRIES GUILD

(At Lancaster Room, Caxton Hall, London, S.W.1., 6.30 p.m.)

Internal Coating. J. Rogers, M.A., M.Sc.Tech. **10 January**

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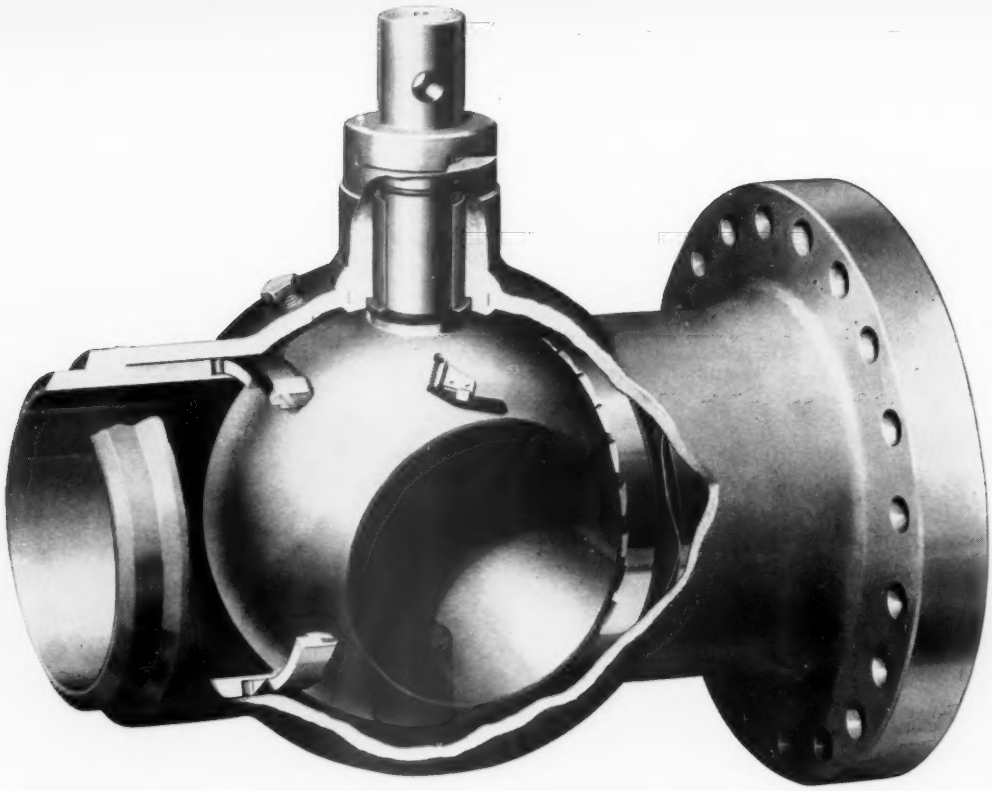

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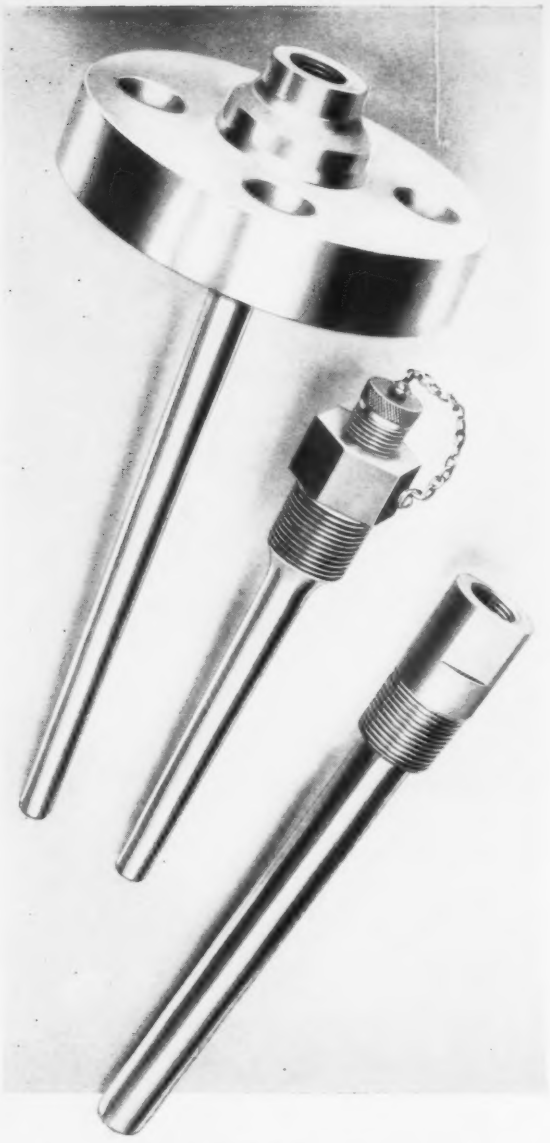

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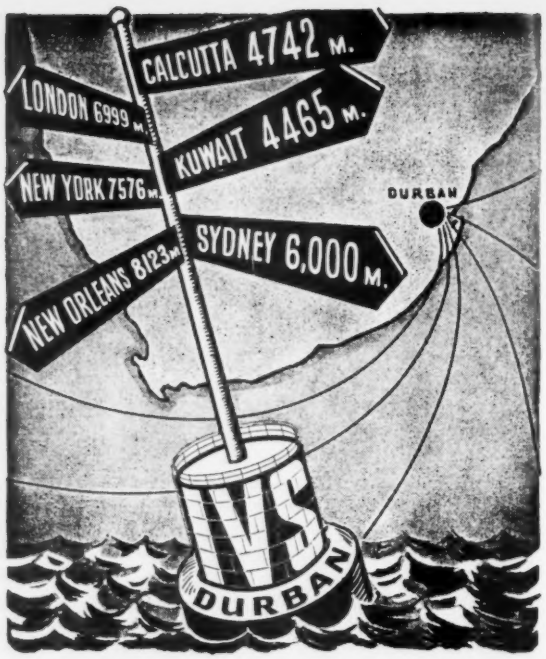

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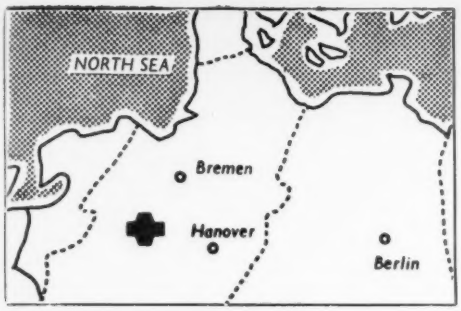

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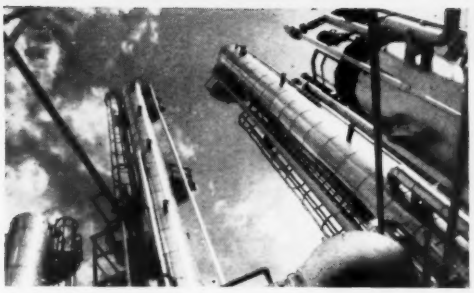
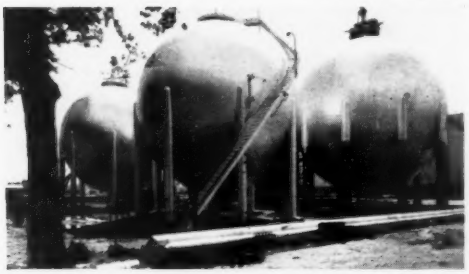


Process Unit Towers



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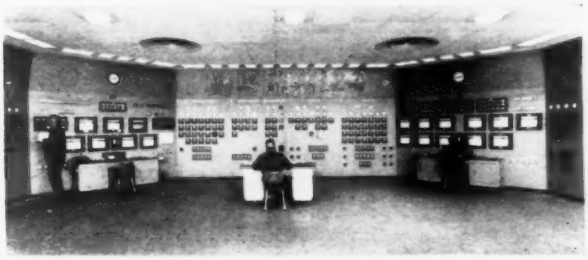
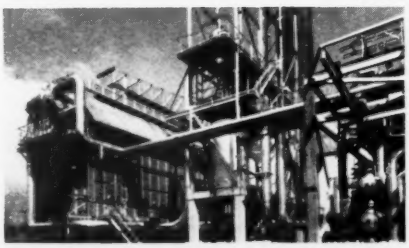
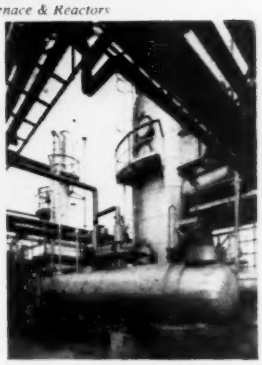


Process Units Control Room



Process Unit Furnace & Reactors

Aerial View



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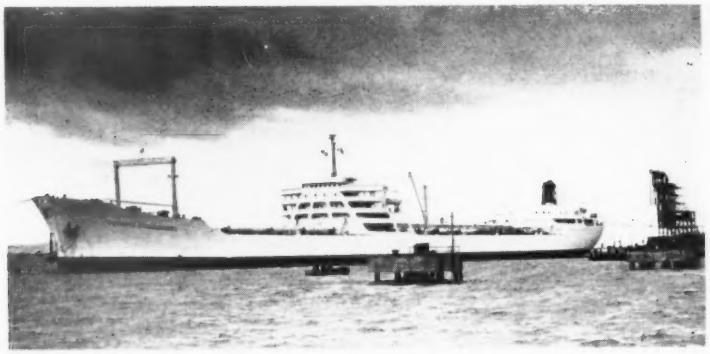

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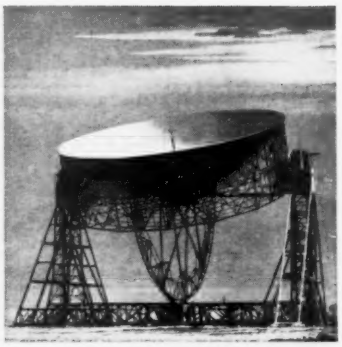

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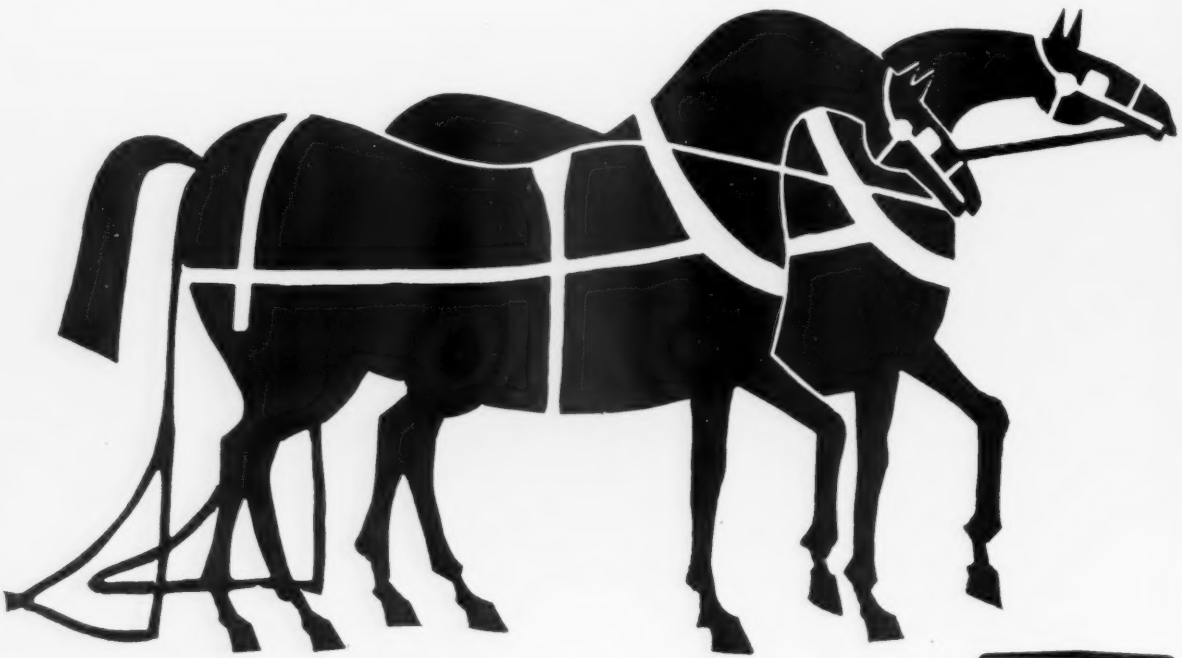

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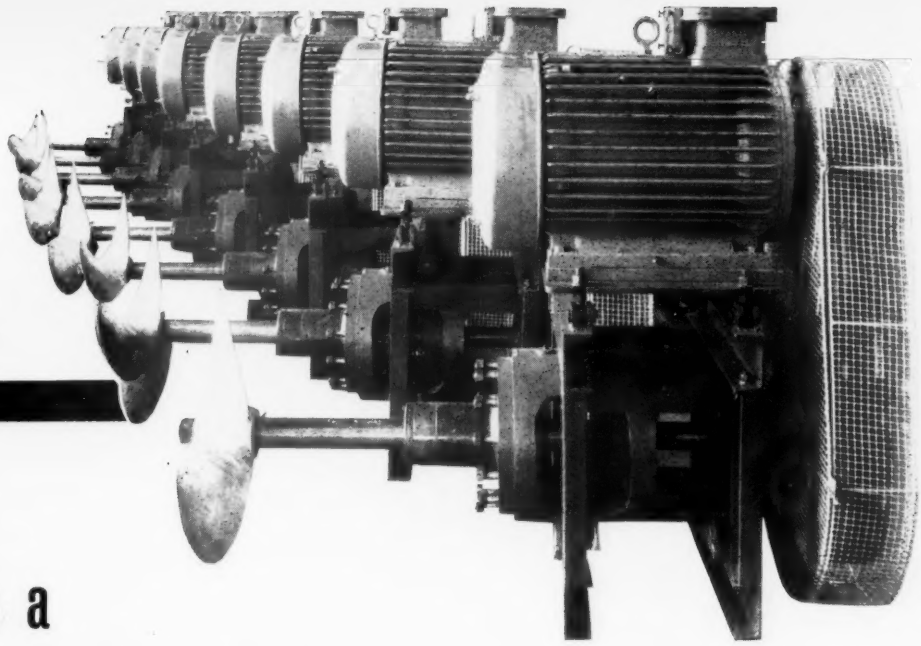

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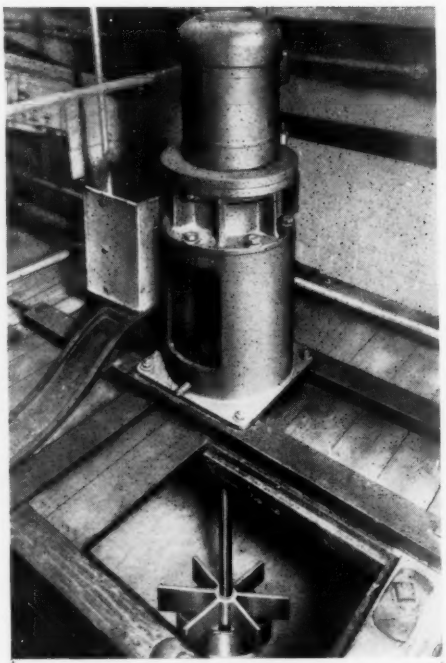

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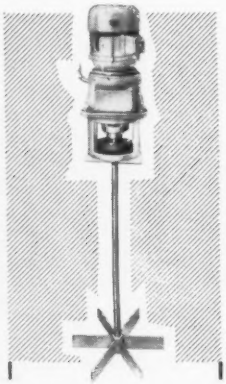

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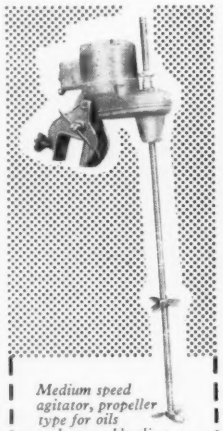

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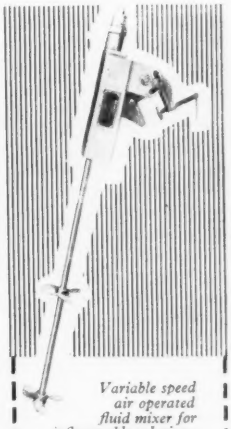

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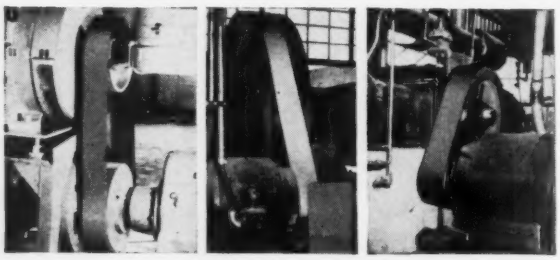

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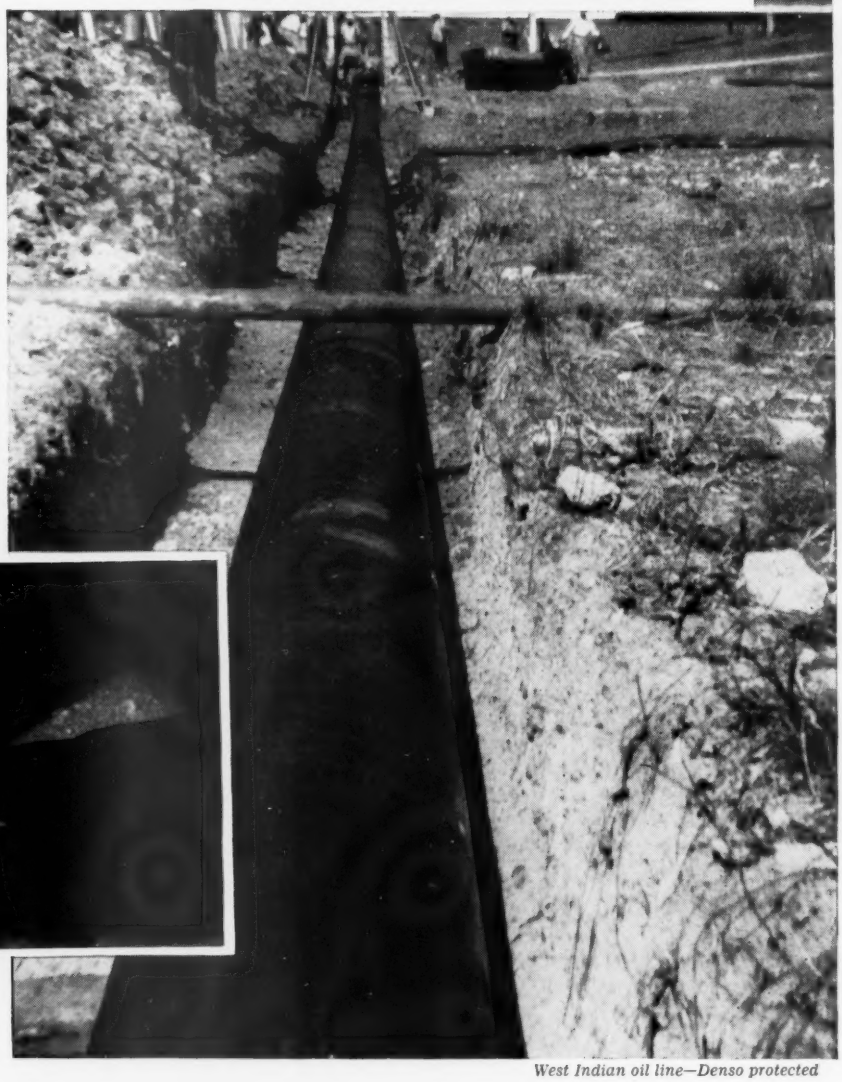

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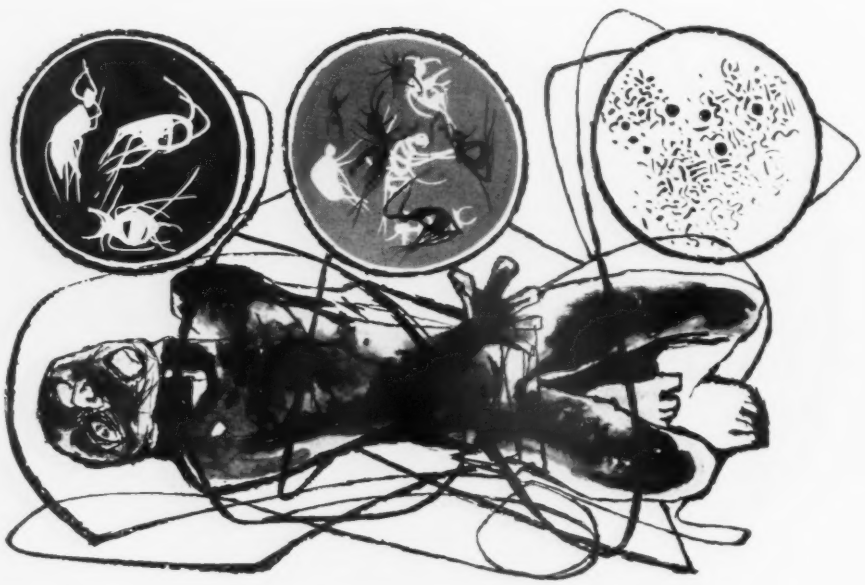

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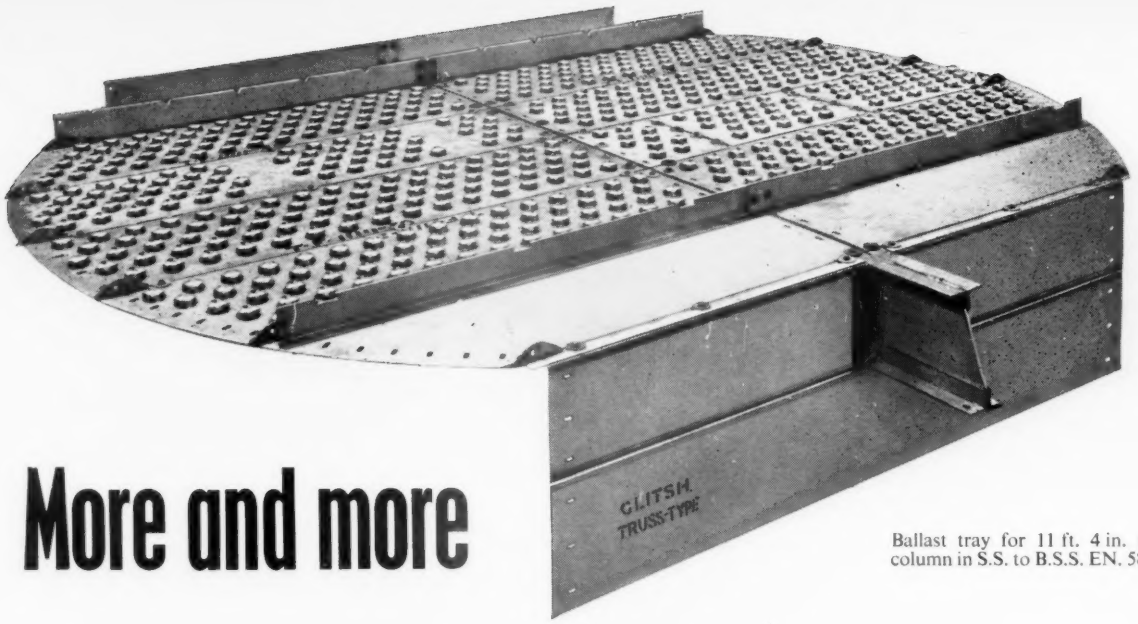

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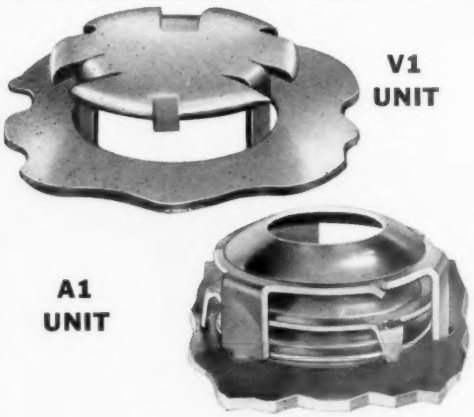

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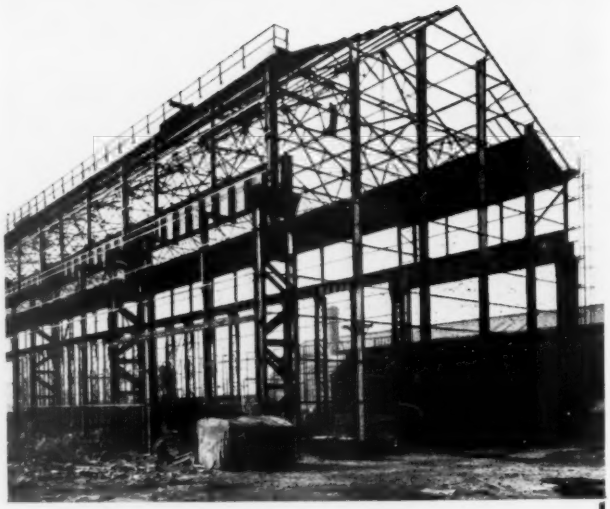

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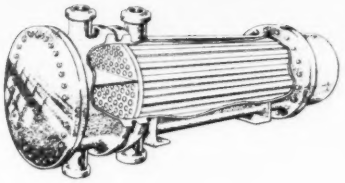

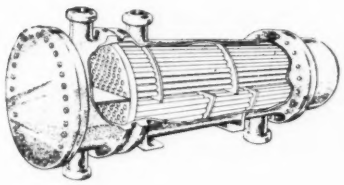

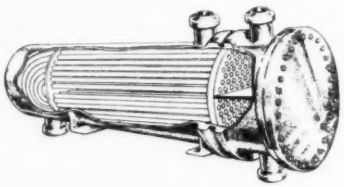

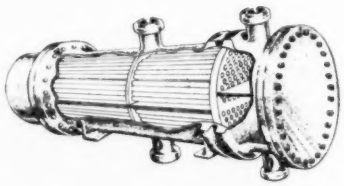

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YORKSHIRE IMPERIAL

ADVERTISERS IN THE IP REVIEW, 1960

(Advertising Agencies in italics)

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Anchor Chemical Co. Ltd *(Mayfair Advertising Ltd)*	Sept.
Audley Engineering Co. Ltd *(Edward Hilton Advertising Ltd)*	Nov.
Beldam Asbestos Co. Ltd *(Lashbrook Advertising)*	Mar.
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Victor Blagden & Co. Ltd *(Press & General Publicity Service Ltd)*	Nov.
Blaw-Knox Chemical Engineering Co. Ltd *(Auld & Tilbury Ltd)*	July
Thos. Boorn & Co. Ltd	June
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